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Editorial Comments

Cliff Quay Power Station, Ipswich.

In this issue will be found a description of the construction of the river works of the new Electricity Power Station near the Port of Ipswich, which is scheduled under the British Electricity Authority programme as one of the main power stations of the national grid system.

A scheme for an electricity station had been put in hand already by the Ipswich Corporation prior to the nationalisation of electricity supplies, and was almost completed when the station was handed over to the British Electricity Authority in March, 1948; it was, however, greatly modified to meet the requirements of the power grid system of the United Kingdom.

The Port of Ipswich lies at the head of the estuary of the River Orwell, Suffolk, and is about twelve miles inland. The convenient geographical position of the town has made it an important industrial centre, and in the immediate vicinity of the port there are a number of large engineering works, flour and grain mills, oil and spirit depots and timber yards.

The present Port Authority is the Ipswich Dock Commission, which is responsible for the administration of the docks and also the conservancy of the River Orwell. Its jurisdiction extends from an imaginary line drawn from Shotley Point to Fagborough Cliff in the estuary of the Orwell (the limit of the Harwich Harbour Conservancy Board) to Stoke Bridge, Ipswich.

The site for the power station chosen by the Corporation of Ipswich was influenced by the necessity for natural deep water access for the colliers, adequate space and a plentiful supply of cooling water for the turbine condensers. A suitable site was found eastwards of the Cliff Quay, a mile or so from the Wet Dock of the port, where road and railway access was also available.

The total capacity of the six generators installed at the new power station is 270,000 k.w., involving an annual consumption of 650,000 tons of coal and the use of 6,500 tons of cooling water per hour. The storage of coal in adequate quantity to tide over any interference with normal coal deliveries has been guarded against by a storage space of seventeen acres, while ash disposal —which in power stations situated in built-up areas presents a difficulty not easily overcome—has been solved by the allocation of an area of forty acres, which will thus be reclaimed from the River Orwell.

It is easy to see that the siting and preliminary requirements connected with a power station project of such magnitude sets some difficult problems before the engineers in charge of their design and those concerned with the conservancy and navigation of the rivers upon which the stations are necessarily situated for the purpose of ensuring that ample provision is made for the cheap transport of coal and for adequate supplies of cooling water.

The problems of the conservators of the rivers upon which the plants are built are, besides navigational, greatly connected with the temperature of the discharged cooling water, its purity and oxygen content, together with the velocities of intake and discharge, all of which are of vital importance from river purification and siltation points of view. This is especially the case with those rivers whose banks are largely industrialised and which, in consequence, already receive considerable quantities of trade wastes, sewerage and storm water effluents. For example, in the navigable portion of the River Thames, there are upwards of twelve or more electric generating stations either built or building, besides which there are many gas generating works, all of which require circulating water in large quantities.

The problem is further complicated if the Ministry of Health in industrial and built-up areas prescribes that the flue gases must be washed, to abate smoke and acid irritants being discharged into the air.

Such considerations having been apparently overcome in the Ipswich Power Station, we would draw attention to the lay-out of the power plant itself, which in general appears to follow normal practice.

It will be observed that the intake and discharge culverts are 1,000 feet apart, and may be assumed to have been so sited and designed that the river and tidal currents will ensure that hot water is not drawn into the intake culvert on a falling tide. The circulating water culverts are ingeniously placed between twin rows of steel sheet piling which, with similar riverside rows of piling, effectively reclaim the area for coal storage and transporters; while the pump-house, with its six pumping chambers, is situated at the downstream end of the coaling jetty, alongside which is the dredged collier berth, forming also the intake channel to the pumps. The essence of the design of the whole of the river works appears to be simplicity and the use of a considerable amount of pre-cast concrete work in the construction of the jetty.

All concerned with its design and construction are to be congratulated upon the production of a power station which has much to recommend it, both from civil engineering and æsthetic points of view.

Editorial Comments—continued

Tidal Features of Southampton Water.

The article on a subsequent page, describing an investigation into the double tide phenomena of Southampton Water, we think will be studied with some interest. The data obtained and tabulated, while of considerable value, is not intended by the author to be regarded as offering any solution of the exact causes of the phenomena, and although research by the Liverpool Tidal Institute, and the Admiralty, has exploded many of the older theories, it has been realised that no simple explanation can be given as to the mode of production of this unusual tidal feature.

As the author of this article points out, very extensive observations of tide levels over a wide adjacent area, including sites remote from the shore, would be needed over long periods before any mathematical analysis could be undertaken with any hope of success in finding the origins of the local tides.

To fully understand in every detail the causes of the double high water and other features, may not be of paramount importance to the Southampton Harbour Board at the moment, seeing that accurate tidal predictions have been and are periodically produced by the Liverpool Tidal Institute. It seems, however, that it may be desirable, sooner or later, for the precise causes of the phenomena to be ascertained for the purpose of making fully certain that no man made structures or alteration to the sea bed could possibly adversely affect the present conditions in Southampton Water which constitute enormous tidal advantages for the development of port facilities for the world's largest liners.

While the double high water levels have been given much prominence in the past, it is clear that future dredged levels in the ship channels are greatly bound up with the lesser publicised step or flat feature of the young flood tide.

All those concerned with tidal work generally will look forward to an eventual solution of the problem which has intrigued men for over a thousand years.

Conference on East African Transport Problems.

Early last month a series of meetings was held at the Colonial Office to discuss general transport questions in East Africa, to review the present position at the Port of Dar es Salaam, and to investigate ways and means of enabling it to carry a tonnage sufficient to meet the requirements of all port users, including the Overseas Food Corporation. An official statement subsequently issued said that the problem resolved itself into two parts, the immediate handling of an increased volume of traffic and the more permanent matter of increasing the capacity of the port to accord with the developing economy of the territories it serves.

The Conference first turned its attention to the cargo handling capacity of the port. Dar es Salaam is a lighterage port situated on a tidal basin and entered through a narrow channel which is subject to fast tides. The lack of quay space is a limiting factor. While the present 1,460 feet of quay is being extended by 500 feet, no increase in the area beyond the quay can be made because of the close proximity of the town.

The present lighter fleet of 32 units will be increased by the addition of six Thames barges of 200 ton capacity and two Mincas of 120 ton capacity, to come into service from the beginning of March, and a further twenty 200 ton barges will be coming into operation at the rate of two a month from April onwards.

The existing twelve cranes will have been increased to fifteen by the same time, and additional rolling stock will be available at the rate of five wagons per month from the beginning of April.

With these increased facilities, it is hoped that the short term estimated monthly imports of 27,000 tons from ocean-going vessels through the port will be handled with reasonable expedition, and that the stevedoring and other cargo handling interests will be able to give shipping the turn-round it is entitled to expect. The Conference also noted that the East African Transport Administration has already decided to construct two deep water berths at the Port of Dar es Salaam to deal with the further increase of traffic to be expected in the future. The first of these berths should be in operation at the end of 1951 and the second in 1952.

Turning its attention to the more general problem of the longer term developments of communications in East and Central Africa, the Conference noted that the proposal was already in an advanced stage of consideration to arrange to survey alternative routes which would provide a railway link between the Rhodesian and East African railway systems (the North-South link) and also the route, Broken-Hill Mikindani. The former will be a comprehensive engineering survey accompanied by economic surveys of the areas which the railways are expected to serve. The latter will be a quick reconnaissance designed to ascertain whether the Broken-Hill Mikindani route is likely to be a practicable proposition. On the results of this would depend the decision whether to carry out comprehensive engineering and economic surveys on the lines proposed for the North-South link. American aid is being sought with respect to these proposals. That part of the North-South link which would join the Tanganyika system with Mombasa is regarded as of the greatest importance, particularly as it would provide a spillway through Mombasa and Tanga should Das es Salaam prove incapable of handling the increased volume of traffic which is likely to arise following the economic development of Tanga.

We understand that a Technical Committee in East Africa is now investigating the possibilities of Dar es Salaam being developed beyond the present contemplated extensions, and this Committee's report, which is expected to be published within the next few weeks, will be studied with interest by all those concerned with the future of the African Colonies.

The Port of Sunderland Improvement Schemes.

In our issue for December last, we published an article describing the first aluminium alloy bascule bridge to be constructed and erected in this country, and editorially we commented that it formed part of an extensive improvement scheme in the Port of Sunderland, which had been outlined in a previous article which appeared in October, 1945.

As many of our readers will be aware, Sunderland is not only a harbour with a large general coastal and overseas trade, but is also a great shipbuilding centre, where vessels of considerable variety and size are built for all of the world's trade routes. Moreover, as far back as Tudor times, Sunderland was a port for the shipping of coal, and this commodity is still one of the port's principal exports.

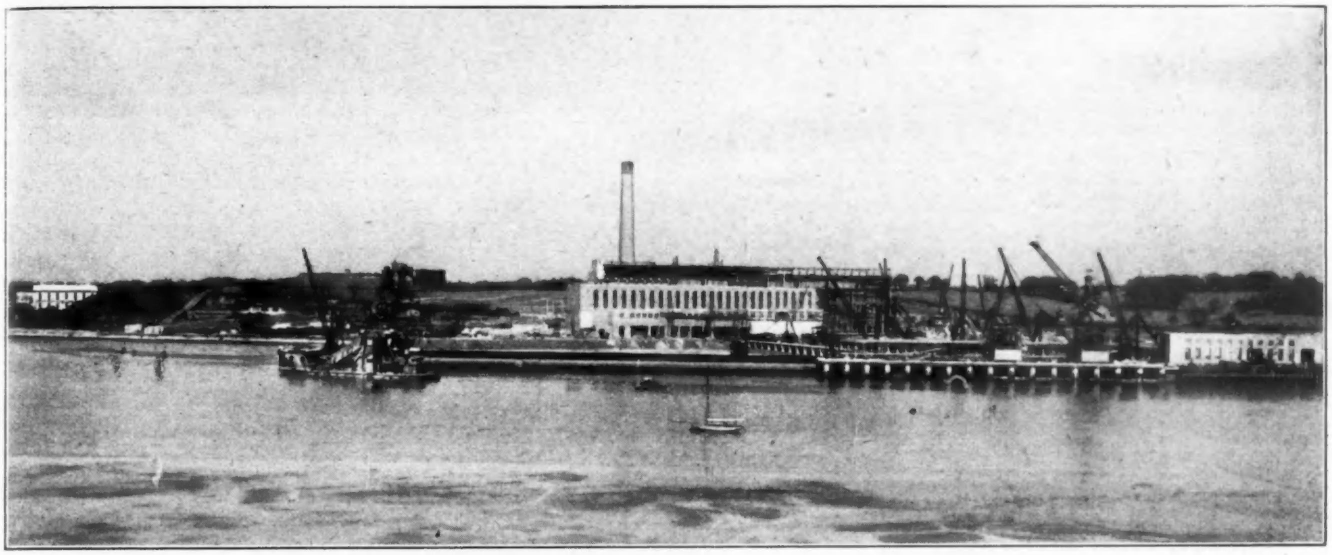
The Eight-Scheme Development Programme approved by the Ministry of Transport, and described on a subsequent page, was planned by the River Wear Commissioners in 1942, and considerable progress appears to have been made towards completion of the several items, the majority of which are improvements in general lay-out and quay extension, land reclamation, and the widening and deepening of the harbour entrance. Additional proposals are also planned, for example, the provision of new inner piers and wave basins, and, in collaboration with the Sunderland Corporation, an extension of Corporation Quay.

In connection with the harbour entrance works, it is interesting to note that a large-scale model of the entrance has been constructed, and that data is being obtained from which it will be decided as to what form the scheme for new inner piers and basins should take to ensure minimum turbulence in the lower reaches of the River Wear and ideal conditions for navigation in the entrance to the harbour.

Our readers will find much of interest in the text of the article and the photographs and plans which accompany it, and it will be generally agreed that the complete programme indicates a degree of foresight and enterprise on the part of the Commissioners which is most commendable.

Improvements at the Port of Liverpool.

A scheme has been approved by the Mersey Docks and Harbour Board for extensive improvements in handling Irish cross-channel vessels and for the greater convenience of their passengers. The plan is designed to take advantage of the forthcoming opening of the Waterloo dock entrance. This will enable the steamers to dock or leave at any stage of the tide and passengers to embark or disembark in the dock, the vessels being able to operate independently of the landing stages when required. Much time and inconvenience will thus be saved. A passengers' waiting room is included in the structural features of the scheme.



View of Cliff Quay Power Station looking across River Orwell.

Cliff Quay Power Station

Construction of River Works and Coaling Jetty near the Port of Ipswich

By OLIVER DAWSON, B.Sc., A.M.I.C.E.

Introduction

Cliff Quay Power Station is scheduled as one of the main base load power stations under the British Electricity Authority's new programme. It is unique in that so far it is the largest power station in this country to be designed for building up to its ultimate capacity without a break in construction. The total installed capacity of the six generators will be 270,000 kilowatts. It is also the first station in which there are no switches between the generators and the 132 K.V. sub-station, all switching being carried out at the 132 K.V. pressure. The scheme for the station was first originated by the Electricity Department of the Ipswich Corporation, but was greatly modified by the Central Electricity Board, who wished to construct a power station that would form part of the national grid. When the station was handed over to the British Electricity Authority in March, 1948, it was well on the way towards completion.

The site chosen by the Ipswich Corporation on the bank of the River Orwell has the natural advantage of access from a navigable channel, a deep water berth, and a plentiful supply of cooling water for the turbine condensers. Fig. 1 shows the relation of the power station to the Port of Ipswich, while Fig. 2 shows a recent aerial view looking up the river towards Ipswich.

The power station is dependent on the river for its supply of cooling water and the transport of coal. As the annual consumption of coal will be of the order of 650,000 tons, a jetty had to be built to allow for the berthing of colliers at all states of the tide. Cooling water is also required at the rate of 6,500 tons per hour. From these figures it can be seen that the river will play a very important part in the working of the station.

The coal unloading jetty and the pump house to supply the cooling water were constructed adjacent to each other. This allowed the dredging for the ship berth and the pump intakes to be carried out in one operation.

Both the jetty and the pump house are about 700-ft. from the river bank, which called for the construction of an access causeway. The outlet for the cooling water, which is about 1,000 feet from the intake, called for a second access causeway. In order to enclose a section of the river foreshore for the storage of coal, the two causeways are connected by a third causeway. The area of foreshore enclosed in the cofferdam formed by the three causeway arms is 17 acres.

For the disposal of ash a second enclosure was made of the river foreshore. The area of this enclosure is 40 acres. This area will take many years to fill, but when complete it should form a valuable additional site for future development. Fig. 3 gives a clear idea of the extent of these river works. In this artist's impression can be seen a collier being unloaded and the cooling water pump-house superstructure. A plan of the river works is shown in Fig. 4.

The construction of these extensive river works resolved itself into three sections of operations. They were: the driving of the steel pile arms or causeways forming the coal enclosure; the construction of the circulating or cooling water pump-house in a steel pile cofferdam; and the construction of the R.C. Coaling Jetty. In practice these three operations overlapped to a certain extent, but for the sake of clarity they will be described separately.

Construction of Steel Pile Enclosure for Coal Store and Ash Disposal

Description:

Both the coal and ash enclosures are enclosed by a double row of steel sheet piles about 20 feet apart. The two rows are tied together with tie bolts and walings so that filling could be placed in between. The type of piling was Larssen No. 2 and varied in length from 15 to 45 feet. Altogether about 7,230 piles, weighing 3,670 tons, had to be driven. Where the double row of steel piles was not filled by the inlet or outlet culverts for the cooling water they were filled with selected material which was excavated from a borrow pit on the site. Selected material was not tipped between the two rows of piles forming the ash enclosure, as it is intended to fill the space with ash when the power station comes into operation. The plan of the River Works (Fig. 4) shows the layout of the steel pile enclosures.

Method of Driving Piles:

The piles were driven using 5-ton steam cranes and No. 7 McKiernan-Terry hammers. Steam was supplied for the hammers from separate No. 20 Spencer-Hopwood boilers. Both the crane and the boiler was carried on a steel gantry which stood on the

Cliff Quay Power Station—continued

sheet piles already driven. In order to move the gantry forward, it was split up into three short lengths. Each length was sufficient to carry the crane and the boiler. The crane picked up each section and moved them forward on to a new length of piles.

The steel piles were driven in pairs. A pitching frame sufficient to take 8 pairs (4 pairs on each side) was bolted to the back piling and lined in by a theodolite before the piles were driven. When a right angle corner was reached, a short timber gantry was driven and a turntable used to turn the crane and boiler.

All material was brought to the ash enclosure and the south arm of the coal enclosure by converted L.C.M. landing craft; and by jubilee track to the east and west arms.

walls and gave extra stability to the dam. The diaphragms had the advantage of simplifying the design of the temporary steel waling frames and of locating any blows that might have occurred during excavation. Sufficient steel frames were made up for four out of the six cells. The cells were excavated and concreted in a sequence starting from the east side of the cofferdam and working towards the west.

The construction called for the driving of 1,095 tons of No. 3 and No. 5 Section Larssen Piles. The length of the piles varied from 50 to 71 feet. They were driven by either a 10B3 or No. 9 McKiernan-Terry double acting hammer. Two 10-ton, 120-ft. jib derricks covered the cofferdam. The excavation was carried

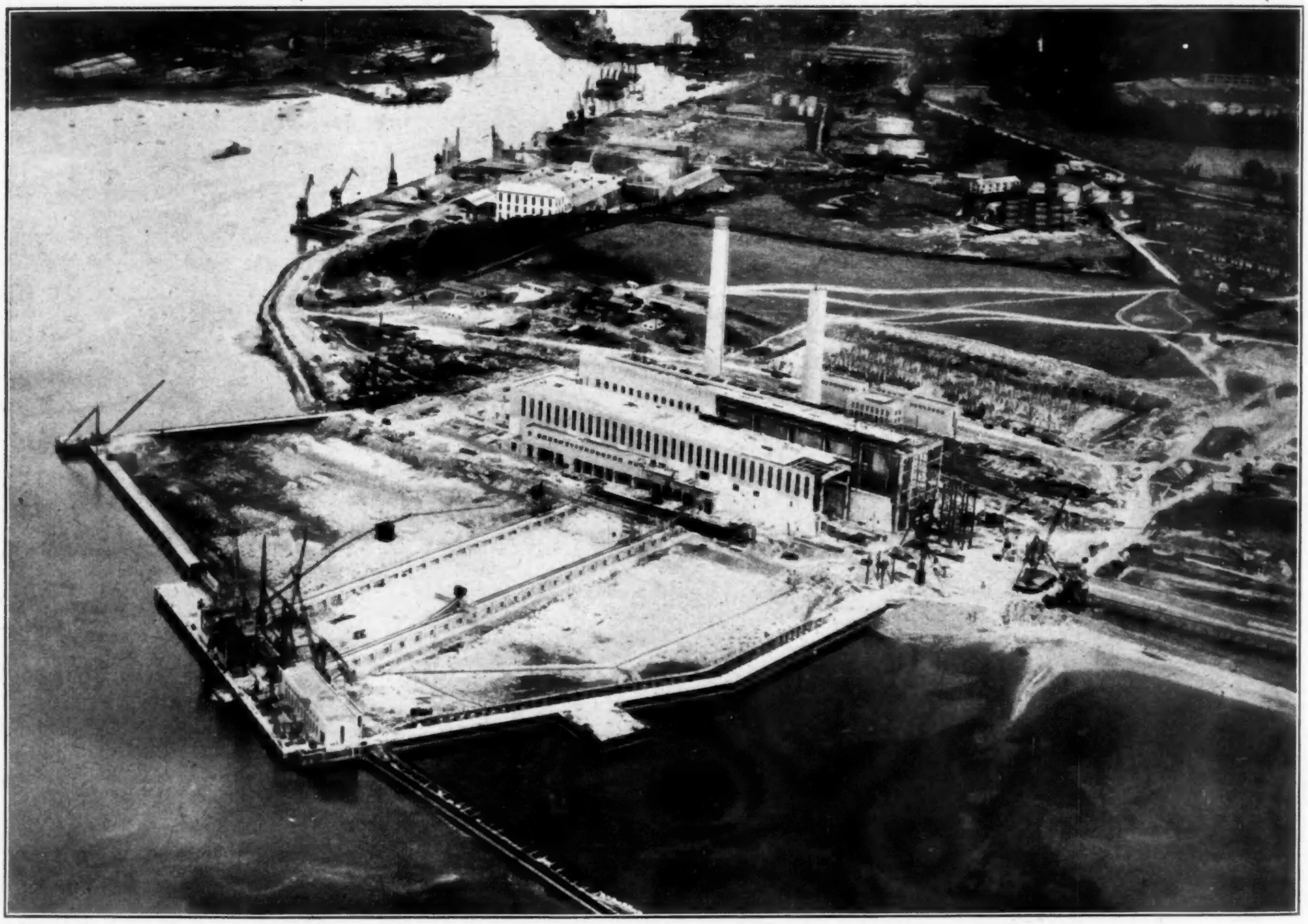


Fig. 2.—Aerial view showing Power Station nearing completion, July, 1948, with Ipswich Docks in background.

Before the steel pile enclosure to coal store was completed, work was started on the main pump-house cofferdam. Access to the site of this cofferdam was gained by constructing a temporary timber jetty.

Construction of C.W. Pump-House in a Steel Pile Cofferdam

Description:

The construction of the main C.W. pump chambers called for a cofferdam about 120 feet by 80 feet in plan. The general level of the excavation was about 37 feet below high water. A toe trench was carried down another 10 feet below general excavation level. Fig. 4 shows the reinforced concrete pump chambers which were built in the cofferdam.

A number of alternative forms of cofferdam were investigated. It was eventually decided to construct the cofferdam in six separate cells, each cell corresponding with the permanent pump cells. The additional pile diaphragms corresponded with the permanent

out by grabs using two 5-ton steam loco cranes on top of the temporary steel framework on the cofferdam.

Temporary drainage was carried out by means of an extension to the cofferdam that had been constructed for a pier head as a temporary sump. Drains were laid through the six cells to lead the water back to the main pump sump. The amount of water to be pumped varied with the tide and the state of the excavation. Three electric centrifugal pumps were installed, one 10-inch, one 8-inch and one 6-inch. These three pumps allowed sufficient margin for a stand-by pump. They were standard pumps made by Messrs. Gwynnes, Drysdale and Worthington Simpson.

The mass concrete was placed by pumping from the central batching plant. This method allowed the placing of a 300 cubic yard lift in one day. The concrete pump line was about 1,100 feet long and 6 inches diameter. The reinforced concrete walls to the permanent pump cells were shuttered and concreted by skips in the normal way.

Cliff Quay Power Station—continued

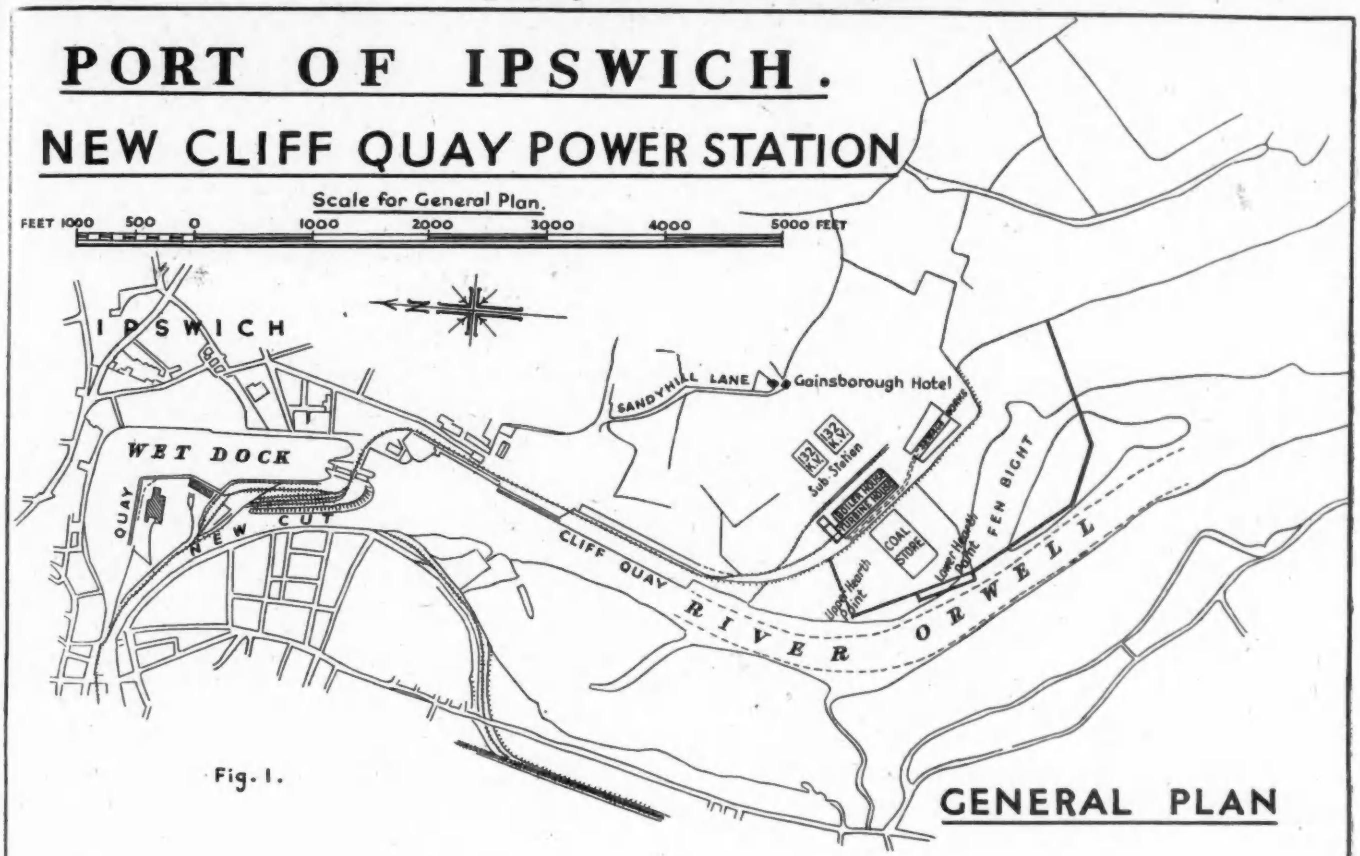


Fig. 1.

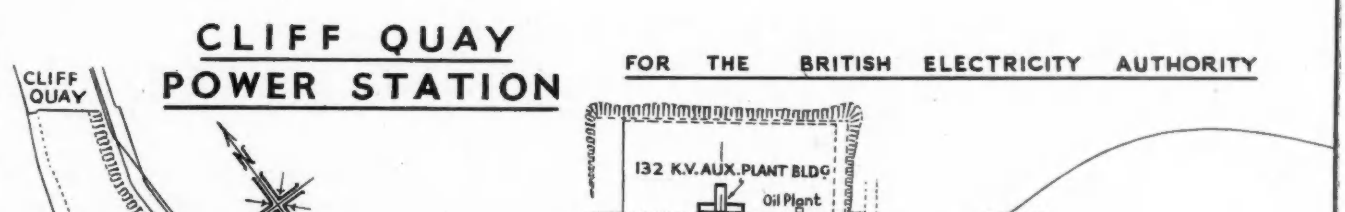


Fig. 4.

Cliff Quay Power Station—continued

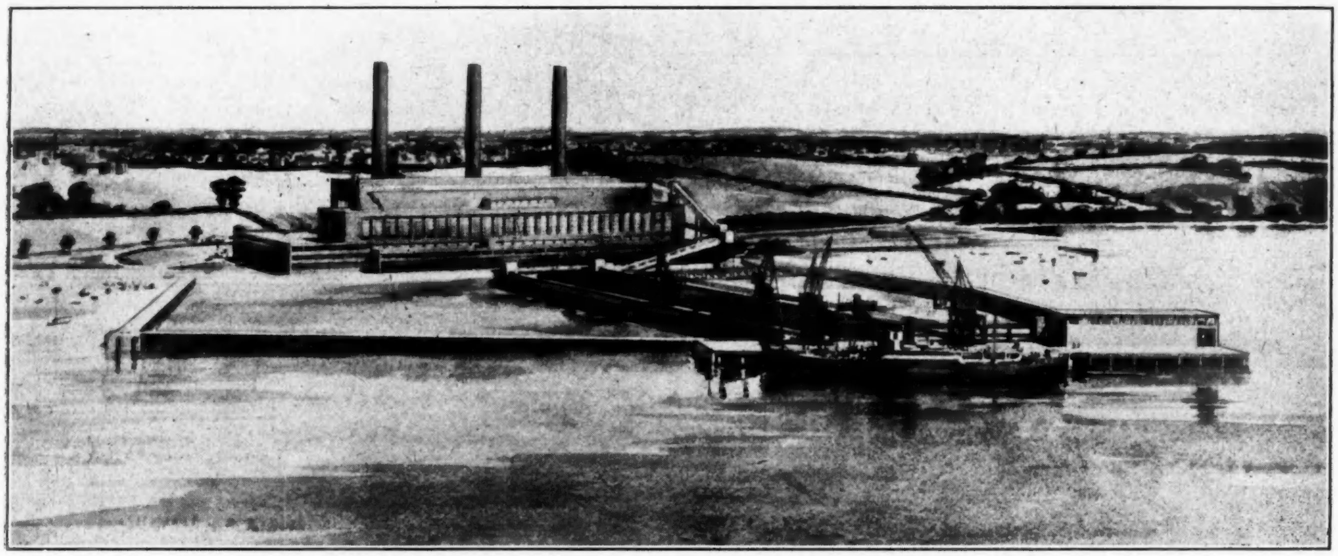


Fig. 3.—Artist's impression showing Power Station and River Works.

All the intake openings for the water to the permanent circulating water pumps were closed by large sluice gates. These sluice gates allowed the temporary cofferdam steel piling to be removed after the reinforced concrete walls had been constructed. The removal of the steel piles was carried out by cutting along the line of piles with oxy-acetylene cutting torches, at a level about 20 feet below low water. The cutting was carried out in the dry from the inside of the cofferdam before it was flooded, thus eliminating divers' work.

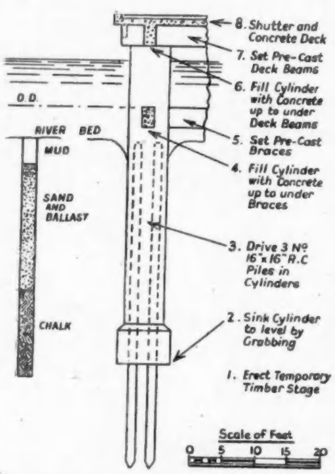


Fig. 5.—Showing order of operations in construction of Jetty.

After the piles had been cut off, the river bed in front of the cofferdam was dredged away and the cofferdam flooded. The piles were extracted, using a B.S.P. Zenith extractor and one of the 10-ton derricks. This dredging, and the dredging of the collier berth in front of the jetty, was carried out by the Tilbury Contracting & Dredging Co., Ltd., to a level about 24 feet below low water. The tidal range is 13 feet at spring tides.

A temporary timber access jetty also allowed work to start on the reinforced concrete coaling jetty while the pump-house cofferdam was under construction.

Construction of Reinforced Concrete Coaling Jetty

Description:

The coal unloading jetty consists of a reinforced concrete slab supported on 34 cylinders and 17 independent groups of 18-in. by 18-in. reinforced concrete piles. The deck slab is about 53 feet wide by 350 feet long.

Each cylinder is made from pre-cast concrete tubes mounted on a base chamber. The base chambers are 8 feet in diameter and the cylinders are 6 feet in diameter. The cylinders were supplied in 10 feet lengths, that could be handled by the 10-ton derricks covering the work. Reinforced concrete piles were driven through the cylinders to increase their stability after they had been sunk to level. The cylinders were filled with concrete and tied together with pre-cast concrete braces at river bed level.

The concrete deck slab is supported on pre-cast concrete beams. All the pre-cast beams and braces were made to be handled by the derricks.

Method of Construction:

The construction of the jetty was carried out in eight overlapping operations. These eight operations are illustrated by a drawing of a typical cylinder shown in Fig. 5. The first operation was the construction of a temporary timber pile stage over the area of the jetty. This temporary jetty was extended and moved forward in four stages. The first stage covered 12 cylinders, the second six cylinders, the third ten cylinders, and the fourth six cylinders. Four 10-ton, 120-foot jib derricks were erected on pile gabbards so as to command the main staging.

The second operation was the sinking of the cylinders by grabbing with a ⅓ cubic yard Priestman orange-peel grab on a 5-ton steam loco crane working on the staging. In order to increase the speed of the work, a second 5-ton loco crane was introduced later in the work.

After the cylinders had been sunk to level, three 16-in. by 16-in. reinforced concrete piles were driven in each cylinder. The piles were driven by a 10B3 automatic hammer hung from a 10-ton derrick. This was the third operation.

Next a concrete seal was placed under water, using a tremie pipe. The cylinders were de-watered and filled with concrete in the dry to brace level.

The level to which the cutting edge of the cylinders had to be sunk was 39 feet below O.D. In practice it was not possible to stop at the exact level. Out of the 34 cylinders sunk, 21 reached a level within 6 inches of either side of the exact level. The remaining 12 varied within 3 feet of either side of the design level. As the top of each cylinder had to finish at a design level of 3 feet below O.D., and the length of the base chamber and three sections of cylinder was 37 feet 6 inches, the last cylinder had to be cut to level. In a few cases the cylinders were too low and an extra length of cylinder was used and cut down to level.

Pre-cast concrete braces were set in place between tides. The junctions of the braces were shuttered and concreted also between tides. The top of the concrete junctions were shaped to take the top length of pre-cast cylinder.

The top lengths of cylinder were placed in position and concreted to underside of beam level and the pre-cast concrete beams were set above high water level, using the derricks.

The deck of the jetty was the only part which was not pre-cast. The shuttering for the concrete deck was hung from a portable steel frame, which rested on the pre-cast beams. The concrete was placed by skips and the 10-ton derricks.

Cliff Quay Power Station—continued

Mounted on the completed jetty are two Stothert & Pitt coal handling cranes, and provision has been made for a third.

Conclusion

The construction of the river works was started at the beginning of 1945, and the first collier was unloaded in the autumn of 1948.

Mr. G. A. Vowles, who was Manager of the Electricity Department of the Ipswich Corporation, was responsible for the station from its commencement until he left to take up his present post as Divisional Controller of the Yorkshire Area, British Electricity Authority. Mr. W. N. C. Clinch, who is the Divisional Controller of the Eastern Division, British Electricity Authority, then became responsible for the station.

The Consulting Engineers for the complete station are Messrs. Merz & McLellan, while the Consulting Engineers for the Civil Engineering work are Sir Alexander Gibb & Partners. The principal Civil Engineering Contractors are Messrs. Edmund Nuttall, Sons & Co. (London), Ltd., who were responsible for all the river works and the construction of all the buildings and foundations.

Pilferage Prevention at Singapore Docks

Drastic Methods of Auxiliary Police Force

By ERIC MITCHELL.*

Ex-commandos, parachutists, and other war veterans are earning £18 a week guarding Singapore's docks. They are Singapore's insurance against complete disruption of the huge port's administration—already attempted at least once, unsuccessfully—by Chinese Communist insurgents.

On the 1st October last, Mr. Henry Basten, Chairman of the Singapore Harbour Board, paid a glowing tribute to the Board's "private" police force—probably the highest paid police force in the world.

He said that no major case of looting or pilferage had occurred in the S.H.B. area for the past two months, reflecting credit on the efficiency of the Singapore Harbour Board Police Detachment, which maintain a ceaseless 24-hour vigil against crime.

The Singapore Harbour Board used to be one of the worst areas of criminal activity in the colony. The Board, and local merchants, were at one time losing over £2,000 a day from pilferage and looting by armed gangsters, who, unscrupulous in the use of their weapons, raided the harbour warehouses almost every night. Arriving in sampans, in one haul they would take away thousands of dollars worth of textiles and other goods. Gun battles between rival gangs, and with the police, were a daily occurrence. Communist-inspired strikes and labour disputes—proemial activity of the present Communist insurgence in Malaya—were virtually paralysing the great Eastern port.

A fight between the Singapore Harbour Board Auxiliary Police and Godown looters.

Then, at a cost of £200,000, and on the recommendation of a special government committee who were appointed to advise on the serious problem of large scale looting, the Singapore Harbour Board Auxiliary Police Detachment was raised.

*Former Snr. Insp. Singapore Harbour Board Auxiliary Police Detachment.

The Auxiliary Police Officers (A.P.O.'s)—the term "A.P.O." has no connection with the "Admiralty Police Officers," the government police who guard Naval dockyards—were recruited from service personnel who were nearing demobilisation, and now number 150 men and 18 officers. The officers include two ex-Metropolitan Policemen (one of them ex-C.I.D.), two parachutists who saw service at Arnhem, an ex-Marine Commando officer, and a former member of the British Diplomatic Service.

The plain-clothes squad ("Mata-Gelap" or "Eye in the Dark") rendezvous for attack.

The men have a number of former "Desert Rats," commandos and paratroopers in their ranks, and, though mostly European, include a sprinkling of Asiatics, some of whom were formerly of the famous Force 136. The force was commanded by Mr. J. H. Davies, of Rhyl, North Wales, himself an ex-commando. He recently relinquished his appointment when he returned to the U.K. on a well-earned six months' leave.

The men are paid £53 a month in cash, plus a deferred gratuity of £20 a month payable on expiration of each contract. The Senior Inspectors and Chief Inspectors receive £59 and £65 respectively. Accommodation and uniform is supplied free, and the men themselves pay about £9 10s. 0d. a month for food.

The last raid in the Singapore Harbour Board by armed gangsters took place on the 28th April, 1947—two days before the new police force went on duty. On that occasion, a native detective was bribed £800 (a sum indicative of the magnitude of the harbour looters' proceeds from their stolen goods) for the comparatively small service of obtaining a warehouse key. A trap was set and in an ensuing gun-fight with the police a number of the looters were killed and the remainder arrested. The latter were all sentenced to long terms of imprisonment.

This unique police force—its members have been described in the local press as "Peace-time Commandos"—has done an exemplary job in the past year and a half. They have broken up the murder and intimidation which was causing all the labour troubles that since the liberation has been costing the Singapore Harbour Board thousands of dollars, and virtually eliminated pilfering and looting.

The Port of Singapore has a very tight security system. Any-

Pilferage Prevention at Singapore Docks—continued

one who has legitimate business within the docks has to have a pass. As the Singapore Harbour Board employ about 20,000 labourers a day, in addition to their clerks, storemen, traffic supervisors, etc., the inauguration of this system was a task of the greatest magnitude.

Legislation was passed under a special emergency proclamation introduced by Lord Louis Mountbatten during the British Military Administration of 1946, and which has never been rescinded, giving the police powers to shoot to kill any unauthorised person seen in the harbour area, and sailing in any craft within 300 feet of the quayside, after dark. The ten gates are manned by the Auxiliary Police, who inspect all passes and search everyone who leaves the dock area. Every warehouse is guarded by an A.P.O.

At first, the A.P.O.'s had a tough job. If they made an arrest, the whole labour force would surround the policeman and threaten him with baling hooks. In those early days, there were one or two nasty incidents involving the A.P.O.'s who, in self defence, were compelled to fire on a hostile crowd of "coolies." All the A.P.O.'s are armed with .38 revolvers.

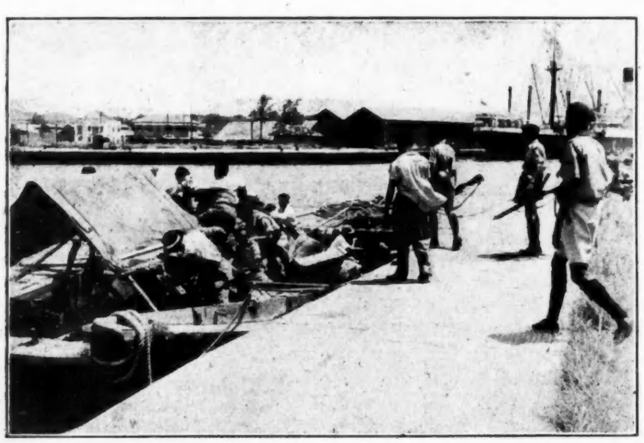
On one occasion, the A.P.O. on duty in one particular warehouse (or "Godown" as it is called in Singapore) was informed by the clerk that four known looters were mingling with the labour force. The A.P.O. went out of the warehouse to give the impression that he was going for coffee, then dashed in by another door. Three of the looters were standing guard, while the fourth was in the act of breaking open a case of textiles. The A.P.O. chased him and eventually caught him between two stacks of packing cases. The looter turned at bay and attacked with his baling hook. The A.P.O. shot him dead.

It was owing to the danger entailed when a lone policeman found himself duty bound to make an arrest, that an electric alarm system was installed. The pressing of a button in any warehouse rings a bell in the police station, where there is always a riot squad standing by. The alarm registers the number of the warehouse on an automatic indicator, and the riot squad, thus warned, can rush in Jeeps to the scene of the trouble within a matter of minutes.

The ordinary petty pilferers and looters soon found that their particular branch of crime did not pay. The police and harbour authorities then found that they had a different, and much more difficult to detect, type of crime to contend with. Large-scale thefts were perpetrated by the use of forged delivery lists and other systems of documentary falsification.

Consequently a plain-clothes squad was formed, and another special uniformed squad who are exclusively employed on the "out" gates. The latter have been specially trained in the Harbour Board's complicated system of documentation. Quite a number of arrests have been effected, and the Harbour Board saved thousands of dollars by these two specially trained squads.

The care with which native labour has to be handled makes the job of the Singapore Harbour Policeman unique compared



A sampan is raided at the last moment.

The last sampan gang is arrested by the Auxiliary Police.

with other dock policemen. Tact and diplomacy are necessary attributes of any policeman; to the S.H.B.'s auxiliary police they are indispensable virtues.

The A.P.O. is employed by the Singapore Harbour Board and it is to them he owes his first loyalty. He has therefore to be extremely careful that the S.H.B. labourers are not given an excuse to use their one weapon against which the police and employers are impotent. A strike of any duration would probably cost the Harbour Board much more than the same period of unrestricted looting.

Singapore's native labour is illiterate and uneducated—extremely susceptible material for Communist agitators and propagandists. It is not uncommon, when a labourer has been arrested, proved guilty and sentenced to gaol, for the union to call a strike and send an ultimatum to the S.H.B. and government demanding the offender's immediate release. On such occasions, the police have to be called out in force to quell disturbances in the labourers' quarters and deal with intimidators and pickets.

The labourers consist of Malays, Chinese and Indians. The trouble starts when, if it happens to be the Indians who are striking, the Malays and Chinese having no interest in the Indians' grievance, attempt to go to work as usual. The Indians try to stop them, with the result that riots and disturbances are rife during the period of the strike. It is then that the A.P.O.'s have to get really tough.

The original Communist plot for creating economic disorder in Malaya started with the Singapore Harbour Board. In April last year, the Communist-led Singapore Federation of Trade Unions (to which the harbour unions are all affiliated) tried by violent methods—murder, intimidation and instigation of paralysing strikes—to cause a stoppage in the Harbour Board and bring the whole port to a standstill.

Various courses of action were adopted by the Singapore Harbour Police in conjunction with the Singapore C.I.D., the most notable of which (it was for three days front-page news in the local press) was the raiding of union premises and the arrest of union leaders, who were Chinese Communists. Many documents were seized, which were subsequently of invaluable assistance in fighting the Communist uprising which started in full force barely two months later. Some of the arrested Chinese were banished from the country.

These tough "Peace-time Commandos" have completed their first year's contract, and are now well into their second year. Just as, not so long ago, they cleansed the world of the evils of Fascism and dictatorship, they have now cleared Singapore's waterfront of the scum who were a legacy of the Japanese.

There seems little doubt that this unique force is so invaluable to the Singapore Harbour Board, that though they were only originally recruited for what was then considered to be a transient period of crime, despite the enormous cost of their upkeep, they will ultimately become a permanent establishment.

The Port of Sunderland

Progress Report of Improvement Schemes

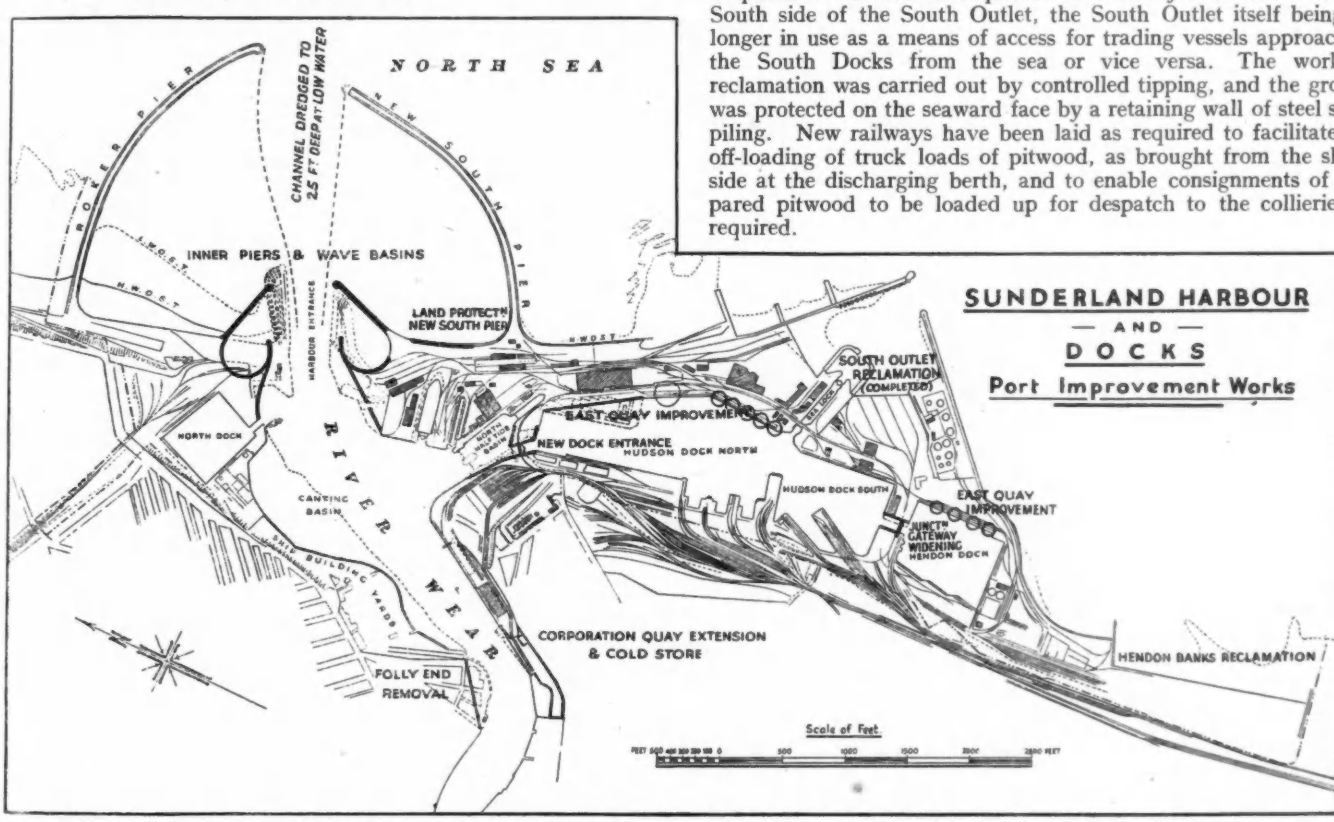
By A. H. J. BOWN, A.C.I.S., M.Inst.T.
(General Manager and Clerk, River Wear Commissioners, and General Manager, Sunderland Corporation Quay).

In the October, 1945 issue of *The Dock and Harbour Authority*, an article appeared describing the Port of Sunderland, and referring to the far-reaching Port Development Schemes which were planned by the River Wear Commissioners as far back as 1942. Since that date, good progress has been made, and the following account shows the present position.

The works now in hand consist of an Eight-Scheme Development Programme and include the following:—

(1) The reclamation of four acres of ground from the sea at the South Outlet.

(2) The reclamation of twelve acres of ground from the sea at the Hendon Banks Barrier which is at the southern extremity of the Commissioners' Docks Estate.



Wear into the South Docks System (which consists of the Half-Tide Basin, the Hudson Dock North, the Hudson Dock South and the Hendon Dock).

(b) The provision of new inner piers and wave basins at the River Entrance to replace the existing inner piers.

(c) The improvement of the existing rail exchange facilities, as between the Commissioners' Dock Railways and the adjoining premises of the Railway Executive, North Eastern Region.

(d) The extension of the Sunderland Corporation Quay for a distance of about 500-ft. upstream, and the erection upon such extension of a riverside Cold Store. This is a Sunderland Corporation Scheme.

Turning to the detail of the above-mentioned works, and taking first the two land reclamation schemes, these have been made necessary as a consequence of the continuing demands of the pitwood and timber importing trades. The need for the creation of more land for storage and transit purposes has been intensified by the loss of certain areas of pre-war common user ground, owing to the expansion of industries established on the Dock Estate. The four acre reclamation scheme at the South Outlet has been completed at the estimated cost of £19,700, and is in full use for the measuring, cutting and piling of imported pitwood prior to its despatch to collieries as required. The newly-won area is on the South side of the South Outlet, the South Outlet itself being no longer in use as a means of access for trading vessels approaching the South Docks from the sea or vice versa. The work of reclamation was carried out by controlled tipping, and the ground was protected on the seaward face by a retaining wall of steel sheet piling. New railways have been laid as required to facilitate the off-loading of truck loads of pitwood, as brought from the ship's side at the discharging berth, and to enable consignments of prepared pitwood to be loaded up for despatch to the collieries as required.

(3) A new sea wall, and land protection measures at the root of the New South Pier.

(4) The widening and deepening of the junction cut which connects the Hudson Dock with the Hendon Dock.

(5) The improvement of the East Side Hendon Dock, together with the improvement of the East Quay South, Hudson Dock.

(6) The straightening and deepening of the Harbour Entrance Channel.

(7) The removal of the area of land known as Folly End on the North side of the River Wear, approximately opposite the Commissioners' new Fish Quay.

(8) The widening of the River Wear by the removal of an area of land near Wearmouth Bridge, also on the North side of the River Wear.

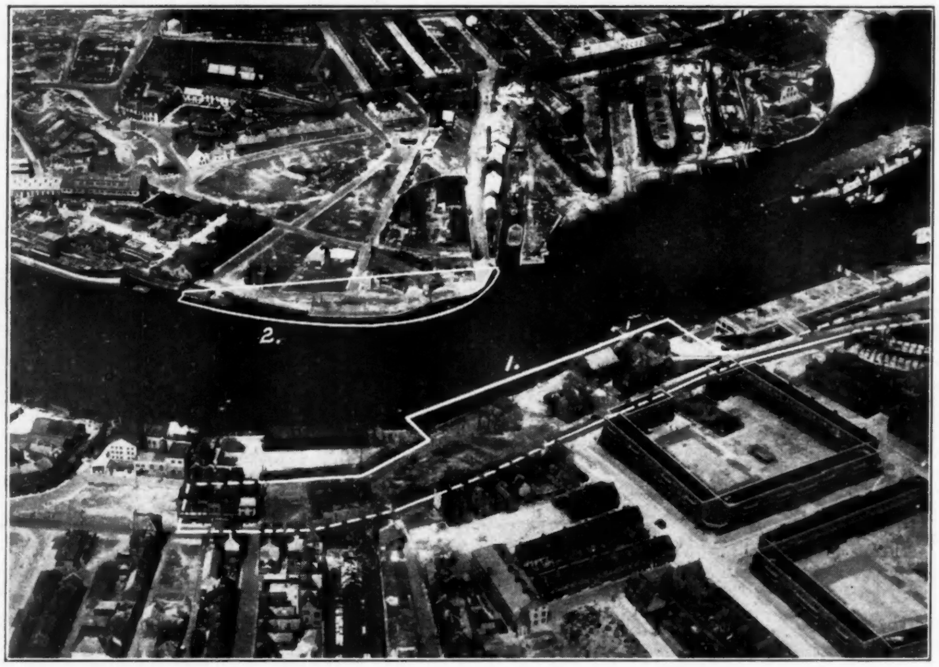
In addition to the above-mentioned authorised programme, work upon which is now well advanced, the following additional proposals are being considered:—

(a) The improvement of the existing entrance from the River

The larger reclamation scheme, 12 acres in all, at the Hendon Banks Barrier, is estimated to cost £165,363, and this work also is approaching the completion stage. The main principle of construction was the same as at the South Outlet, namely, controlled tipping retained by steel sheet piling. A concrete sea defence deck 36-ft. wide and 1,656-ft. long has been laid down along the seaward front of the new ground, with a dwarf sea wall 5-ft. high along its inner line. The tipping and sheet piling are finished, and the only work remaining to be done is some amount of levelling, and the laying of the necessary dock railways to enable the new ground to be efficiently worked as a storage area for pitwood, timber and other goods capable of outdoor storage.

The work at the root of the New South Pier is also finished at the approximate cost of £14,137. The problem here was to adopt measures which would prevent a potentially useful tract of ground from being frequently wave-swept and partially flooded. This has been achieved by raising the parapet of the sea wall by heights varying from 2 to 8-ft., over a length of 890-ft.

The Port of Sunderland—continued



Aerial view showing: (1) Site of Sunderland Corporation Quay, Extension Scheme; and (2) Site of Folly End Removal Scheme.

The widening and deepening of the Junction Cut, and the improvement of two cargo working quays, mentioned above as two separate schemes, are closely inter-linked in their intention. The East Quay South is in the Hudson Dock North, and is by far the best-equipped general cargo quay in the Commissioners' Docks. It has four 5-ton electric cranes of the level luffing type, four quayside railway tracks, good working room behind the railways, and a useful light warehouse 134-ft. by 51-ft. erected by the War Department during the war, and subsequently acquired by the Commissioners. The cranes are fitted with grab equipment for iron ore discharge for which this berth is much used. There is a depth of water alongside this quay amounting to 30-ft., and the deepest-draught vessels capable of entering the dock at H.W.O.S.T., namely, vessels drawing up to 26-ft. 6-in., can therefore be accommodated at this berth. It was at the East Quay South that almost continuous work proceeded during the later years of the war in the loading of large mixed general cargoes of Government Stores. On the other hand, the berth known as East Side Hendon Dock, though situate in a dock having a general average depth of water of 29-ft. 6-in., is not at present so well-appointed for cargo-working purposes as the East Quay South, Hudson Dock. The Hendon Dock Quay has a good length (700-ft.) and, as already mentioned, there is a good depth of water alongside. But the cranes, four in number, are old-fashioned electric cranes, too short in the jib for modern requirements, and of 3 tons capacity only. There are two railway lines alongside at present, and until recently there were no quayside buildings capable of being put to use for the storage of cargo.

The essential part of the improvements now in hand in connection with these two quays, is the provision, at the East Quay, Hudson Dock, of five new 6-ton level luffing cranes to which grabs will be fitted when necessary. The existing cranes on that quay have a maximum radius of 46-ft. 6-in., and they are just capable of plumbing the middle of the hatch of the average 10,000 tons iron ore carrier. It has been decided that, in addition to a greater lifting capacity, a greater maximum radius is desirable, and that of the new cranes will be 60-ft. It is at present proposed to move the four 3-ton cranes now standing at the East Side Hendon Dock around the end of that dock to new positions at No. 11 Berth, which is part of the South Side of the Hendon Dock. After the five new 6-ton cranes have been erected at the East Quay South, Hudson Dock it is intended partially to dismantle the four 5-ton cranes now standing at that quay to transport them to the East Side Hendon Dock with the aid of a floating crane and to re-assemble them there.

Another feature of the improved arrangements at the East Side Hendon Dock will be the taking over for cargo-working purposes of some of the buildings erected at this place by the Admiralty during the war, and subsequently acquired by the River Wear Commissioners. It is intended to put two or three of these buildings into use as general cargo warehouses—indeed, two of them are already being used for this purpose. The new office building erected by the Admiralty during the war, and used by their tenants as an administrative block, is amongst the property acquired by the Commissioners, and to this building the Commissioners' Traffic Office, formerly established at the West Side Hudson Dock, has already been transferred.

One section of the quay wall at the East Side Hendon Dock will have to be strengthened before it can carry with safety the loads which will be imposed by the heavier cranes and railway traffic now in contemplation.

The last point in connection with these two particular schemes, is the important work of widening and deepening the Hendon Junction which is now very well advanced. The Hendon Dock at Sunderland is approached from the Hudson Dock, and the Hendon Junction is the connecting waterway. The Hudson Dock is approached from the River Wear through the Half-Tide Basin, and vessels entering the Hudson Dock must first pass through No. 1 Gateway at the outer end of the Half-Tide Basin, and then through No. 3 Gateway at the inner end of that basin. Except in rare circumstances, the largest vessel capable of negotiating these entrances, is a vessel with a length of 455-ft., a beam of 61ft. and a draft of 26-ft. 6-in. But hitherto, a vessel of these dimensions could not be passed from the Hudson Dock through the Hendon Junction into the Hendon Dock. The largest vessel capable of admission to the Hendon Dock has been a vessel of beam 52-ft., draft 22-ft. and proportionate length. When the present widening and deepening scheme at the junction is complete, the position will be that any vessel capable of passing from the River Wear into the Hudson Dock, will also be able to pass on, if it is so desired, through the Hendon Junction into the Hendon Dock. Before the present work began, the Hendon Junction had a curved cill and walls with sloping, or "battered," faces; the greatest depth was 23-ft. 6-in. at H.W.O.S.T., and the width was 58-ft. between fenders at cope level (8-ft. above H.W.O.S.T.). When the new work is finished, the width will be 90-ft. and the depth will be 29-ft. 6-in. at H.W.O.S.T. It will be observed that these new dimensions provide a margin of increased capacity which, though not required at present, may prove of great value at some future date when the entrance from the River Wear to the Hudson Dock is made deeper and wider.

It is because of this scheme for the widening and deepening of the Hendon Junction that the new bridge recently opened by the Minister of Transport has been provided. The old bridge was a horizontal swing bridge designed to carry rail, road and pedestrian traffic over the Hendon Junction as it formerly existed. The new junction is half as wide again as the old one and the Commissioners considered that having regard to the available ground, a horizontal swing bridge would be uneconomical in design and in maintenance. It was for that reason that they decided upon a

The Port of Sunderland—continued

double trunnion bascule bridge, the moving leaves of which were to be constructed of aluminium alloy. By the use of this material, the amount of steel which would ordinarily have been required for the entire structure was greatly reduced. The low weight of the aluminium alloy has facilitated construction, and will result in low operating costs. This is the first bridge with moving parts of aluminium alloy to be constructed anywhere in the world and a more detailed description of the structure will be found in the December, 1948 issue of this Journal.

The estimated cost of improving the two quays is £136,200; whilst the estimate for the Hendon Junction scheme, including the new bridge, is £170,000.

The straightening and deepening of the Harbour Entrance Channel is a rock-dredging operation which the Commissioners hope to have completed by the end of the summer of 1952. Work is only possible under calm sea conditions in the best weeks of the year, but it has now been going on from time to time for several years, and the straightening part of the work is finished. The task of deepening the channel will be proceeded with during the summer months of the years 1949 to 1952. The present intention is to remove the rock to a depth of 25-ft. below low water ordinary spring tides. As the spring rise and fall at Sunderland is 14-ft. 6-in., this improvement in the Harbour Entrance Channel will make the port much more generally accessible for trading vessels. At the present time the Commissioners endeavour to maintain a minimum depth of 15½-ft. at the Harbour Entrance at low water ordinary spring tides. The estimated cost of this scheme is £95,500.

The last two schemes to be mentioned in the Eight-Scheme Programme now proceeding, are the two river improvement schemes, one at the Folly End and the other near Wearmouth Bridge. The aim in each case is to widen the river to assist navigation by removing land on the north side of the river. The larger scheme is the Folly End Scheme, and it is hoped to make good progress with the actual work during the course of next year. The task of preparing the site ready for operations, and the accumulation of materials for the work, are well advanced. This scheme is estimated to cost about £107,576. The smaller widening scheme near the Wearmouth Bridge is already in hand, and this is estimated to cost about £86,439. It is hoped that the Folly End Scheme and the scheme near Wearmouth Bridge will both be finished about the end of 1950.

In regard to schemes in contemplation but not yet authorised referred to above as schemes (a), (b) (c) and (d) there is first of all the Commissioners' project for improving the entrance from the River Wear into the Hudson Dock. The dimensions of the largest vessel which can, at the present time, pass through this entrance have been described above, and having regard to the increase in the size of ships in recent years (a process which is still going on) the Commissioners realise very clearly that this entrance, which is of the utmost importance in the handling of the port's traffic, must be made wider and deeper. The Commissioners have been advised in this matter by Sir William Halcrow, M.I.C.E., and he has designed and recommended a new entrance 90-ft. wide, without a lock, which will be capable of admitting vessels up to 600-ft. in length, with a loaded draft of 33-ft. at H.W.O.S.T. Sir William Halcrow's design will also give vessels a straight passsage from the River Wear into the Hudson Dock instead of their having to negotiate the existing angle, which is formed between the Half-Tide Basin and the main axis of the Hudson Dock. The estimated cost of this improvement is £684,250. The Commissioners have applied to the Minister of Transport for permission to proceed with the work at the earliest possible moment.

In connection with the proposed provision of new Inner Piers and Wave Basins at the River Entrance to replace the existing River Piers, some very interesting research work is at present being carried out at Sunderland under the direction of the Commissioners' Engineer and with the advice of Sir William Halcrow, M.I.C.E. The Commissioners have constructed, in a special building, a large scale model of the Sunderland Harbour Entrance. In this model the Outer and Inner Piers are represented together with an area of water, and wave action is mechanically induced in order that the question of range in the lower reaches of the harbour may be studied under varying conditions and with different designs of Inner Piers and Wave basins. Valuable data is steadily being obtained by this means and consultations are now going on between the Commissioners' Engineer and the Scientists at the Hydraulic Research Laboratory at Delft, with a view to improving upon the measuring apparatus now in use at Sunderland. It is confidently expected that the Commissioners will eventually obtain full information from the experiments with this model to enable them to decide upon a scheme for new Inner Piers designed to replace the existing structures (which are about 100 years old) and calculated also to maintain conditions of minimum turbulence at all times in the lower reaches of the River Wear.

The scheme for better railway facilities grows naturally out of all the other improvement schemes now in progress or in contemplation at Sunderland. The Commissioners are convinced that the improvements now proceeding in the docks and in the River Wear at Sunderland will result in the permanent increase of general goods traffic in the port and they are quite certain that the present exchange facilities will not be able to cope efficiently with the future volume of trade. Very fruitful discussions have been held locally with the officials of the Railway Executive and, at an early date, the Commissioners will be applying to the Minister of Transport for permission to proceed with their part of the work that will be necessary to improve the railway inter-working facili-

View showing site of Scheme No. 3 (at the root of the New South Pier) and also Site of New Dock Entrance Scheme (in contemplation).

The Port of Sunderland—continued

ties. It is hoped that the Railway Executive will then, in their turn, declare their own willingness to go on with such part of the work as must be carried out on their premises in order that the desired improvements in railway inter-working may be realised at an early date.

The scheme for the extension of the existing Sunderland Corporation Quay upstream for about 500-ft. (where the extended quay would meet the River Wear Commissioners' new Fish Quay) is the Sunderland Corporation's scheme and will be carried out in pursuance of the Parliamentary Powers conferred upon the Corporation by the Sunderland Corporation Act, 1947. Such an extension of the existing quay and the erection upon it of a modern riverside Cold Store (in pursuance of the Sunderland Corporation Act, 1935), will be a most valuable and necessary addition to the facilities now available at the existing quay, which are already over-taxed from time to time. It is understood that the Sunderland Corporation intend to apply to the Minister of Transport at an early date for permission to proceed with these new works.

Correspondence

To the Editor of *The Dock and Harbour Authority*.

Dear Sir,

Tidal Models

I have read with great interest Dr. Doodson's Paper on Tidal Models published in *The Dock and Harbour Authority* for January. His views of present accepted practice are not flattering, particularly in respect of the lack of resemblance between the behaviour of the tidal stream in nature and in models, and also the erroneous results that do arise from the use of model tidal cycles which represent only average tides.

The surprising thing is that experimenters have been quite prepared to accept the obvious limitations of plunger-operated models for so many years.

It therefore calls for a new approach to the problem of correct model presentation, such as might be indicated in his reference to Dr. Jon Van Veen, Chief of the Research Bureau for Tidal Rivers, Rijkswaterstaat, Holland, by electrical analogy and a model.

In this connection of breaking new ground I would like to be permitted to refer to a model constructed by a well-known firm of Consulting Engineers in Westminster. Working from first principles, they have in their presentation gone a long way to meet the objections raised by Dr. Doodson.

It is to be hoped that details will be published at an early date of this model and of the research work which has also been carried out in connection with it. It will be seen, I am sure, to represent a most important advance in hydraulic model work.

Yours faithfully,
W. ARVON WALES.

Hatch End,
Middlesex.
14th January, 1949.

R.E. (TN) Port and I.W.T. Officers Association

Approximately 180 members of the Royal Engineers (TN) Port, and I.W.T. Officers' Association attended the second annual meeting and reunion held in London recently.

The chairman, Mr.E. A. Lewis, introduced the second President of the Association, Brigadier R. Gardiner, the present Director of Transportation at the War Office who expressed his appreciation of becoming President of the Association in succession to Brigadier R. F. O'D Gage. He outlined the structure of the Transportation Supplementary Reserve and appealed to members to encourage other ranks to enlist and thus overcome one of the major difficulties in the recruitment of the post-war Territorial and Reserve Army.

Full particulars of the Association activities can be obtained from the Hon. Secretary, Mr J. H. Gabony, 8, East Sheen Avenue, London, S.W.14.

Notable Port Personalities

No. LX—Mr. Harry C Brockel

Mr. Harry C. Brockel became associated with the Milwaukee Board of Harbour Commissioners in 1926, following graduation from the Milwaukee public schools. In 1928 he took leave of absence from the Board to gain actual experience in Merchant Marine operations and spent some months in the capacity of ordinary seaman aboard an American vessel, which gave him the opportunity to observe vessel operations and cargo handling, as well as the opportunity to visit various major ports abroad. Upon his return to Milwaukee, he served on the staff of the Harbour Commissioners doing research and statistical work. He also served as assistant to executive offices until January, 1936, when he was appointed secretary to the Board.

MR. HARRY C. BROCKEL
(President, American Association of Port Authorities).

Upon the resignation of Mr. C. U. Smith in January, 1942, Mr. Brockel was appointed Municipal Port Director and has served in that capacity since. As Port Director, he is the chief Executive officer of the Milwaukee Board of Harbour Commissioners, and is in charge of all harbour administrative affairs and the development and operation of the municipal port facilities. During the Second World War he served as a member of the United States Coast Guard reserve, specialising in port security operations.

He has always been active in the promotion of the St. Lawrence Seaway Project and in many other phases of Great Lakes shipping and harbour development, and has appeared before Congressional committees on numerous occasions as witness in transportation matters and other phases of harbour and waterway legislation.

Mr. Brockel was elected President of the American Association of Port Authorities for this year, and in addition holds the following offices: Vice-Chairman, Wisconsin Deep Waterways Commission; Secretary, Great Lakes Harbours Association; Director, National St. Lawrence Association; Director, Mid-Continent World Trade Council; Director, National Rivers and Harbours Congress; Secretary, International Trade Club of Wisconsin.

Coast Protection

A Survey of Beach Stability

By R. R. MINIKIN.

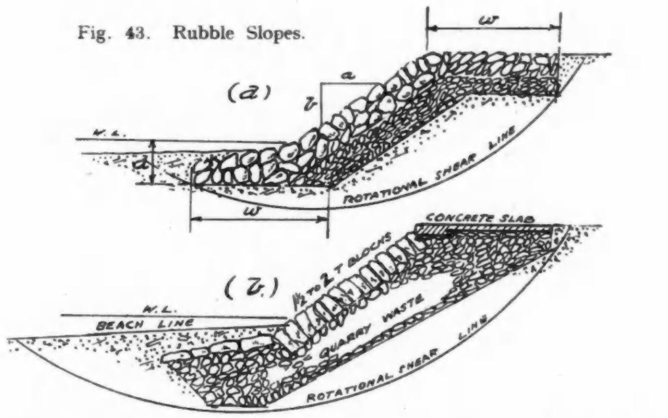
(Continued from page 236)

Form of Protection

(7) Solid Walls

Rubble Slopes. Spanish engineers have found that the form of cross-section shown in Fig. 43 (a) gives very satisfactory results. The stone is rough quarry drawn rubble tipped to a seaward slope of 1 vertical to 2 horizontal, with a toe slope at the beach of 1 in 5. The stone is placed in two layers, the first, or inner layer of lumps weighing 2 to 10-cwt., and the second, or outer layer of blocks weighing 3 to 4 tons. The top mattress extends over the ground to a width of $w = 1\frac{1}{4}$ times the maximum wave height. The base width of the toe is similar and is at about 5-ft. below beach level, at the wall. The thickness of the two blanket layers is usually computed by Dr. Ramon Iribarren's formula and averages 8 to 9-ft. full thickness, of which the outer layer is about 6-ft. Dr. Aurelio Isla, engineer of the works at Arenys de Mar, claims

Fig. 43. Rubble Slopes.



this construction to be cheaper and better adapted to Mediterranean conditions than any other. The theory is very similar to the blanketing of the river bunds in India; should there be any subsidence at the toe the rock lumps of the wall will adjust themselves without collapse, During a heavy storm at Arenys de Mar a stretch of reinforced concrete wall collapsed, whereas the neighbouring section of tipped rock (Fig. 43a) weathered the gale without mishap.

Despite the experience of the Spanish Engineers, the approved cross-section has certain disadvantages for waters of high tidal range and must be designed with care. The weakness lies at the toe: in the crevices between the rock lumps, and the mechanical shearing instability of an earth slope loaded with a heavy rock blanket. Any denudation of the beach robs the slope of its gravity footing at the position where pressure under static forces is greatest. The wash of the water is more severe at this point, and, as the rocks are tipped haphazard, large gaps are left between them through which the surge rushes easily. The turbulence so created is destructive and allows the full force of the rapidly-moving water to act over the full surfaces of the rock lumps tending to lift them out of place. There is also the hazard of overloading the slope beyond the shear strength of the soil along the rotational arc of least resistance.

To avoid these drawbacks it would be of advantage to design the section on the lines of Fig. 43 (b) in which the toe is deeper and heavier, and the facing blocks selected from $1\frac{1}{2}$ to 2-ton blocks of rectangular proportions, laid longways into the slope. The face should be made as flush as possible and all gaps should be a minimum. A preliminary dousing of the gaps with wet sand and

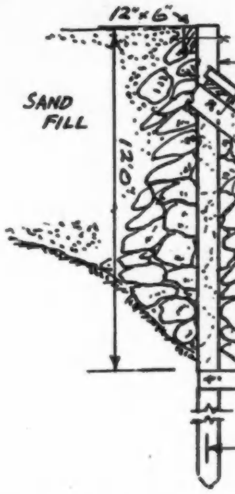


Fig. 44. Rubble Slope held in timber crib.

gravel assists in obtaining the right degree of porosity more quickly.

Stone-filled Cribs. A form of sea wall to be seen on the Portuguese Coast is shown in Fig. 44. It is suitable only for temporary repair or in places where it can be located landward of the high water line. The design is not sufficiently substantial to be effective for any length of time seawards of high water springs although it possesses all the physical features of least detriment to beach regimen. It will be appreciated that combinations of wood and stone, totally dissimilar materials, in constructions where the structural strength is dependent upon that of the weakest material, the timber, can only be satisfactory so long as the latter retains its properties unimpaired. Even then, owing to poor workmanship, or bad design, the strength of the timber may not be sufficiently developed by reason of poor connections. Wire, or cut, nails and small diameter bolts, or spikes, are most unsuitable for marine work. At Espinho, about 100-ft. in front of the above wall and parallel to it, a rock mound is tipped to serve the purpose of a wave breaker and rock-filled timber crib groynes are placed about 200-ft. apart along the beach.

Sloping Walls.—On coasts where there are no rock quarries within economical reach, sea protection walls are usually constructed of sand, clay or shingle embankments, or slopes, faced with a watertight material. Some examples have already been given, as Figs. 23 and 25, and outlines of the cross sections of other popular profiles are shown in Fig. 45 from G. to N. In the main, the line of these walls lies landward of the H.W.O.S.T. line of original beach, with the toe, when originally constructed, several feet below the beach surface, and in many cases further protected by a curtain wall of sheet piling. Sometimes the heads of the sheet piles are incorporated in the concrete of the toe beam. A simple sea wall of this type (Fig. 46) was constructed at Dunkirk, N. France, where H.W. springs was at two-thirds the height up from the toe beam. The whole construction was of pre-cast

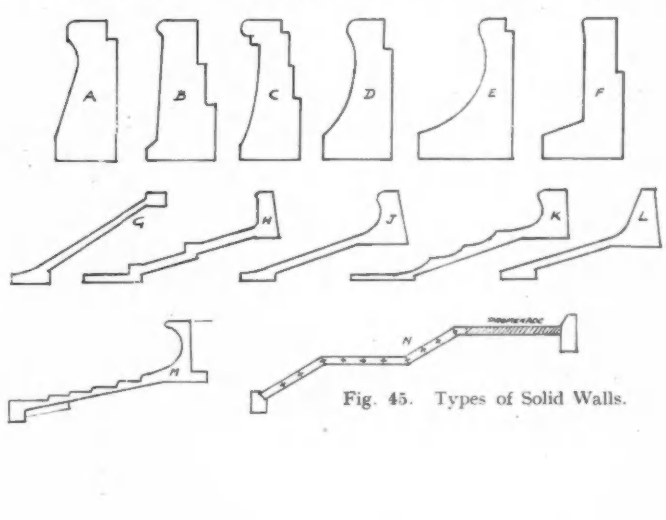


Fig. 45. Types of Solid Walls.

Coast Protection—continued

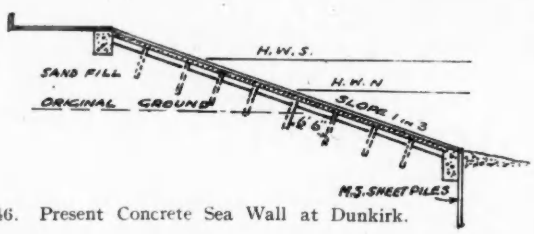


Fig. 46. Present Concrete Sea Wall at Dunkirk.

reinforced concrete, with the exception of the toe and head beams, and the sealing fillets.

The top of the wall is at 7 feet above spring tide and the foot at 10 feet above L.W. springs. The short stakes, or piles, to secure the panel bearers are 6-in. x 6-in. section and 5-ft. long. The bearers are 6½-ft. long and 9-in. x 9-in. cross section. The panel slabs are 6½-ft. long and 2½-ft. x 4-in. cross section; one long side being checked back to house the next slab. A layer, or blanket, of clay 6-in. thick is spread over the slope, on which the bearers are laid and adjusted to line and centres between the toe and head beam, which are cast *in situ*. The toe beam is protected by a 10-ft. long steel sheet pile wall. At the ends of the bearers, slots were left, through which the short concrete piles were driven. These were sunk into place by water jet after a preliminary starting of the hole by spade. The sides of the bearers were checked back to take the ends of the panel slabs. When these were placed, the space between the bottom of the slabs and the clay blanket was filled, and tamped, with gravel and sand, well watered to ensure close contact. The reinforcing bars, projecting at the head of the short piles, already driven in place, were then bent down and an *in situ* cap of concrete poured over the full length of the bearers to lock piles, slabs, and bearers together.

The defects of this type of construction are: the thin scantlings of the reinforced concrete panels not allowing a sufficiency of cover to the steel reinforcement, and the comparatively high stresses to which these thin slabs will be subjected from the wave blows, in spite of the easy slope. There is another point: the drum action of the wave strokes will eventually cause the gravel filling to lose contact with the underside of the slabs, no matter how carefully it was originally packed. This arises from the end support of slabs being transmitted to the piles. Wherever possible a designer of marine works should endeavour to carry all stresses on a structure through compression members. If thin reinforced concrete is to be used for sloping sea walls, it should be laid with the same meticulous care as in the construction of a concrete road, where the tension stresses are a minimum. To achieve this, the sub-foundation should always be well consolidated and the structure designed so that they are always closely married. If the wall is to be split up in panels, it is advisable not to dovetail the joints, but rather to provide a bitumen seal. In this way the slabs may adjust themselves to local settlement without being disturbed from their protective function.

Of the various types of sloping wall shown in Fig. 45, most of them are monolithic and devoid of provision for local adjustment. They are substantially proportioned, and mostly provided with a toe curtain wall of steel sheet piling.

The reasons frequently put forward for the adoption of a sloping face sea wall bear little relation to the factors that go to the preservation or promotion of beach building mechanism. In many cases such walls have been built on a favourable accretion foreshore, and brought about considerable lowering of the average beach level. Even though the beach may extend some distance

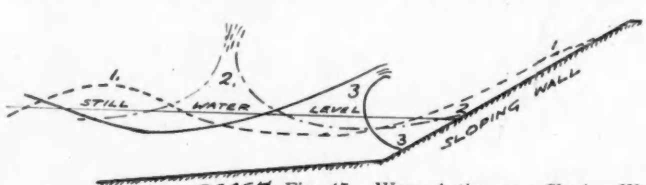


Fig. 47. Wave Action on a Sloping Wall.

up the wall, from the toe, when the latter is originally built, once the surge over-runs this portion and contacts the wall face, the drawdown forces of a submerged beach become operative. The result of this is that the still water level contacts the wall, and the surge, instead of running over a porous beach, rushes up the impermeable slope (Fig. 47) as the dash line (1) indicates. When all the energy of the surge is exhausted, it flows back rapidly into the trough of oncoming wave, resisted only by the surface friction of the wall face. It is now in the condition of a partially reflected wave (clapotis) and the reversed orbital motion of the particles meeting that of the next advancing wave, the excess energy is ejected at the crest, dot and dash line (2). The new wave is not retarded but rushes on, steepening its crest, and breaks near the foot of the wall, full line (3). The photographs (Figs. 48 and 49) show this phenomenon plainly; the former showing in the distance the wave at (1), and in the forefront, the wave at stage (2). Fig. 49 shows in the distance the wave at near (1); in the mid-foreground the partially broken wave (3); and the clapotis (2) in the foreground.

The outcome of this high degree of turbulence generated near the toe of the wall makes it highly improbable that any mobile material can rest on the impermeable face—indeed, not only is the beach, under a frontal wave attack, prevented from building up over the wall face, but it is more than probable that the beach

Fig. 48. The Clapotis effect of a heavy sea causing severe agitation near Sloping Sea Wall.

in front of the toe will be scoured out. Once this happens, the general slope of the beach is diminished (Fig. 50), and it is most difficult to again bring the beach back to its original height, particularly on a sandy foreshore, such as that shown in the illustrations. Should the neap tides leave a dry patch of beach above high water, then given favourable conditions, a crest may again be built up at the toe; or should dry weather and a strong on-shore wind develop during low tides, sufficient sand particles may be blown near the front of the wall to again build up. With a shingle beach an oblique wave front may develop a renewal of accretion, the more so if, after advancing at one obliquity, it veers or backs to another.

During some days of dropping tides a beach was built up to 18-ins. over the toe of a sloping wall. On the return to springs there occurred some increase of wind, generating waves about 5-ft. amplitude. During one high tide, under this sea, the sand was not only depleted from the wall but a trench nearly 2-ft. deep (Fig. 51) was scoured out in the beach at the toe. Still water level during this occurrence was not more than 12-ins. above the toe.

At the toe of a sloping wall of bedded masonry, scouring out at the toe threatened to undermine the wall. The engineers therefore decided to ensure its stability by constructing a stone apron 8-ft. wide with the top surface at the then beach level. All blocks of stone were over 6 cwts. in weight and concreted in with the long sides vertical. The new toe was further protected with 7-in. x 2½-in. timber sheeting driven 6-ft. into the beach. This, however, did not end the depletion of the beach; trenches were again

Coast Protection—continued

scoured out at the toe and the general level of the beach lowered by about 2-ft. A concrete beam, or sill, was therefore cast seaward of the timber sheeting (Fig. 52). It was then decided that as there was no further improvement, on the length concreted, to try an apron of long heavy stones placed endways in the beach at the then beach level. No concrete or binding material was used, so that some degree of porosity was still preserved in the new apron (Fig. 53). Since these works were carried out the beach has remained static, except for occasional temporary changes, at the level of the new apron. Groyning has had no effect, yet in the adjacent bay to the East, where there are no man made constructions, there is a fine naturally accreted sand beach steadily pushing the high water mark seaward.

Various Types of Sloping Wall.—The various types of sloping walls illustrated in Fig. 45, although differing somewhat in shape and economy of construction, do not, as structures, present any advantages in the dissipation of wave surge, and still less in the promotion of beach building; nevertheless, many engineers favour these types. It may be that the interested public authorities influence this decision. From the point of view of appearance they certainly give the impression of sturdiness and a more graceful line than vertical walls. The main advantage of the sloping wall (straight or curved) is the fact that it is better adapted for construction on beaches of poor foundation value, providing any detrimental influence from the land side is prevented, such as the seepage of water through the base engendering a quicksand effect. The static equilibrium is more easily attained and

Fig. 49. The turmoil of waves at the foot of a Sloping Wall showing a draw down over the stepped toe.

maintained, even though the beach at the toe is considerably depleted, than with vertical walls.

Generally speaking, the sloping wall should be the more economical. The impact effect of the breaking wave is not so severe, as only a fraction of the water energy is taken by the wall, the remainder is used up in the upward flush of the water. Though the sloping wall does not entirely eliminate the blow of a breaking wave, or the detonation of the trapped air, it reduces the pressure effects considerably. The surge may flush over the top of the slope and even project green water into the air over the top of the wall, but not with the severe effects associated with a vertical wall.

The introduction of stepped faces on slopes of 1 : 1 or 1 : $1\frac{1}{2}$, such as at Miami, Paignton, Mablethorpe, etc., no doubt arose from the need to provide facilities for beach access, otherwise there is no functional advantage. Of late years stepped faces at flatter slopes, in reinforced concrete, surmounted at the head by a curved or vertical dwarf wall, have been widely constructed. Some of these constructions have an imposing appearance, particularly those with the graceful curved coping. Most of these walls have steps of 6-ins. rise and a level portion (or tread) of 2-ft. It has been said that a greater degree of effectiveness would be provided by rises of 2-ft. How this can come about is difficult to understand. Consider the case where the depth of the water at the toe is not great, say $2\frac{1}{2}$-ft., and waves of equal amplitude.

Fig. 50. Scour at the toe of a wall.

At the break, Fig. 54 (a), the resulting surge will mount the steps as shown in full lines. As the comparatively thin stream of water meets the obstructions, successive ejections of water take place, thus absorbing energy, so that the surge does not mount as high as it would on a straight incline (there is also a lateral spread which assists this dispersion). On the return flow the water returns normally until the depth thins down to the projecting edge of any step, and then the remainder cascades. Hence, with small amounts of water, the steps are effective in destroying the energy of the moving water in both directions. Should the steps be now increased to four times the height at the same equivalent slope we get the condition of Fig. 54 (b).

The position of the break approaches closer to the higher step and the flush passes over the tread with greater violence to meet the vertical face and be ejected upwards—in effect, it becomes a vertical wall. On the return the cascading happens sooner and is not so thin as with the lesser rise.

What, in effect, has taken place is a series of impacts on low vertical walls, which destroys the orbital motion of the particles of what would have been a partially reflected wave. This holds good for waves of small amplitude; but when the depth of the water over the toe allows the closer approach of storm waves the steps are of little value in reducing the energy of the final surge, which is then imposed on the curved, or vertical wall, at the head. In such circumstances what does happen, particularly with a shingle beach, is the scouring out of the beach at the toe and the lateral dispersion of the shingle along the horizontal treads, or shelves. The result is the heaping up of the shingle over one portion of the wall at the expense of another portion. For this reason it is advisable to protect the toe of a sloping wall with sturdy sheet piling, securely tied back into the wall footing. It is also good practice to strengthen up the slab near the toe. As far as structural stability is concerned, it should be borne in mind that the efficiency of a sea-wall is tested only in bad weather, when there is an exceptionally high still water level

Fig. 51. Scour at toe of wall.

Coast Protection—*continued*

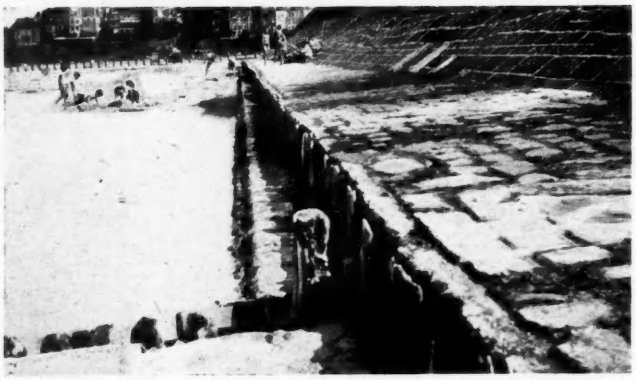


Fig. 52. Concrete Beam cut in beach at the toe of a Sloping Wall.

and heavy breaking seas. As far as the preservation of the beach height is concerned, the shape and location (with reference to high water line) of the wall is tested during moderate weather. These two factors should be considered side by side before final design is settled.

The type of wall G. (Fig. 45) is usually constructed in stone or brick with a heavy concrete toe, laid on staked fascines in a sandy beach. Sometimes the top portion is curved slightly upward to gain promenade width and deflect the green water vertically. The types H. J. and L. are usually of reinforced concrete with flatter slopes than G. The types K. and M. are also of reinforced concrete, the former having dished steps with the intention of projecting the surge upwards into the air at each rise. The functional advantages of these refinements are doubtful and a critical valuation of the beach and amenity conditions would be necessary considerations.

The type N. was evolved as an economical solution of a difficult estuarial problem at Brightlingsea. The original wall was a clay bank with a concrete slab facing, sloping at 1 : 1½. The foundation was in very poor ground, the toe pushed out and the bank subsided. It was decided to reconstruct the wall with a beam, and to use ballast in the additional filling. The facing consists of concrete slabs, in the form of a flexible blanket, cast *in situ*. To allow for possible subsidence the slabs are butt jointed with steel dowels forming the only connection between them. The base of the slab facing rests on a toe beam cast in the mud of the foreshore.

A very interesting point regarding estuarial waters has been brought to my notice by Mr. R. Boast, Surveyor to the Brightlingsea U.D.C. When the wall was first projected it was intended to use well cured pre-cast slabs, but owing to the urgency of the work this had to be abandoned in favour of *in situ* work. This entailed a semi-dry mix for the concrete, with the unfortunate consequence of a somewhat porous material resulting when set. The magnesium and calcium sulphates present in these

Fig. 53. Stone Apron laid in a sand beach at the toe of Sloping Wall.

estuarial waters entered the porous slabs and signs of speedy disintegration became evident. Another point is, that under the slight settling so far noticed, the unsealed butt joints allow the sea water to penetrate the bank, to the detriment of the ballast filling.

Vertical Walls.—It has already been remarked above that there is a general natural tendency for accretion to take place in crescentic bays and for the coastline to eventually straighten out. Now it is a matter of observation that on the less curved coastlines engineers have favoured sloping sea walls, whereas in embayments the vertical wall is most favoured. Naturally there are exceptions, but, in the main, this predilection holds. It, no doubt, arises from consideration of the degree of reliability of foundations. The over-turning moment and forward thrust on a vertical wall, due to the pressure of the back-fill on the land side, represents a constant stress hazard unrelated to its function as a sea-wall, and is an added source of maintenance and capital expense. Again, the deeper one is compelled to take the foundation to obtain the passive resistance at the toe, the more rapidly does the initial outlay increase. With sloping walls, where the spread base ensures that all stresses are vertical, these factors do

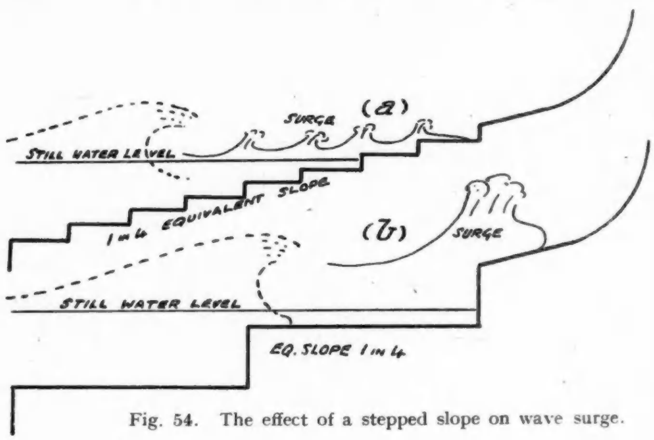


Fig. 54. The effect of a stepped slope on wave surge.

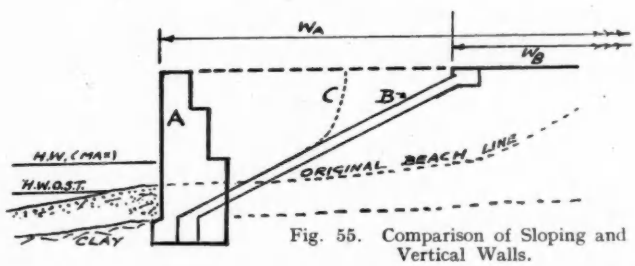


Fig. 55. Comparison of Sloping and Vertical Walls.

not arise. In both cases, of course, the rotational shear of the sub-foundation soil must be considered.

For example, say it is desired to preserve a strip of beach for holiday makers at all states of the tide, the first consideration would be the height of high water springs. This would not be as high as the still water level during storm surges but, in these latitudes, storm periods of any severity usually occur in the winter months, when beach amenities are not in demand. Hence, if the position of a vertical wall and a sloping wall are fixed at A and B (Fig. 55) respectively, a thin strip of beach is left in front of the toe sufficient to ensure a crest for moderate summer seas. The result of this would be the reclaiming of promenade widths Wa and Wb for the two walls respectively.

If the walls were sited to seaward of the H.W.O.S.T. line along the beach, as they frequently are, a much more severe condition must be considered. This condition would also be similar to that of winter storms on the walls as sited in the first example with a maximum high water level as indicated.

On a vertical wall there are two types of waves possible, a breaking wave, which is most severe, and a clapotis, or reflected

Coast Protection—continued

wave, which is not so severe. On a sloping wall, all waves are breaking waves, but the flush of the return flow gives the effect of a partially reflected wave (Fig. 47).

With some appreciable depth of water at the wall the wave may approach the wall as Fig. 56 (a), gradually steepening at the crest, and climbing the wall at the same time, until at the moment of break an air pocket is enclosed between the wall and the folding water. It is then that the boom, or crack, of the wave is heard. The smaller the air pocket the more violent the detonation, the higher the sound-note of the break, and sheets of green water are projected upward with great velocity. The explosion over, the airborne water falls back into the sea (Fig. 57 (a)), but by then the next wave is rushing forward and the water is falling into the trough. At this moment there is developing an internal flow of water toward the oncoming crest (Fig. 57 (b)) from the base of the wall. Thus on the beach near the wall there is a high degree of movement of the water and the mobile particles, first in one direction, then in the opposite. Under a series of violent wave strokes more material may be displaced seawards, or laterally, than is pressed forward, or it may be caught up by the attacking wave and hurled over the top of the wall. As we have already seen, this action will scour out a trench in front of the wall and, whilst the tide is high, if the violence continues, it will eventually result in a flattening of the beach slope.

On the other hand, with a sloping wall, the air pocket enclosed by the breaking wave is comparatively large and the explosion,

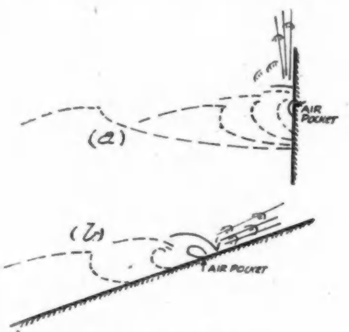


Fig. 56. Breaking Waves on Vertical and Sloping Walls.

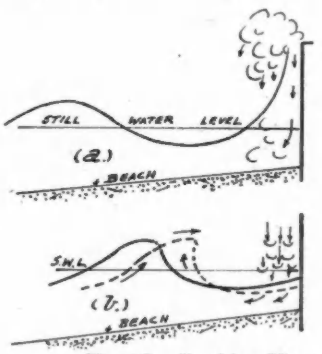


Fig. 57. Breaking Wave on Vertical Wall.

which is signalled by a liquid boom of low pitch, is therefore not so violent. The projected surge (Fig. 56 (b)) flushes upward with lesser velocity than on the vertical wall. The phenomena connected with the return flow has already been discussed.

Research and experience have shown that the breaking wave in its most critical phase exerts high impact pressures against a vertical wall. The consequence is, any unsealed fracture in the wall, that allows the penetration of air or water, may be the means of transmitting high air, or hydraulic, pressures into the wall with serious results.

To avoid scouring of the beach near the wall, the most economical and reliable method is the laying of an unbound rough stone apron of a width equal to half the height of the wall, but not less than 8-ft. The rough quarry stones should be about 3 to 4-ft. long and not less than 3 sq. feet sectional area at the top surface, which should be laid flush with the beach—that is, the long side is embedded. The top surface of the apron, when laid, will then appear like a crazy pavement with 1 to 1½-in. gaps between, filled tight with beach material.

Should the sub-stratum be of rock at the site of the wall, then providing it is at a reasonable depth, the most economical construction would be a vertical wall. On a shingle foreshore it is found that though the body of a vertical wall may be of concrete, it is advisable to face it with hard stone to withstand the battering of the projected shingle. The vertical wall, at times, is the only solution to coast protection problems. For example, at Sandgate, the High Street is only a few yards from the high water line and at the Hythe end actually skirts it. The road level is only about 7-ft. above H.W. Springs and in time past has suffered considerable damage. Within recent years a new vertical wall, as Type F (Fig. 45), has been constructed. It is supported at the toe on bearing piles, and protected by sheet piles driven about 12-ft. into the beach. This was an instance where piling support was indispensable, but, generally speaking, it is not advisable to use bearing piles in sea wall construction if by any other economical means the stability may be ensured. The projecting toe is not an advantage to beach equilibrium.

Fig. 58. Mass Concrete Sea Wall with parapet.

A simple type of sea wall built in plain concrete is shown in Fig. 58. It protects valuable property built within a few feet of the face. At high water there is now a depth of about 5-ft. at the wall. The strand is a flat beach of compact sand. In place of the usual coping there is a 2-ft. high parapet wall, provided with 3 x 12-in. scuppers to discharge any water spilled into the pathway at the rear. Of late years the beach has suffered depletion, and one stretch of wall was threatened by undermining. It was decided to protect this with a heavy apron of quarry stone sealed with concrete and curtained on the outer edge of apron by timber sheeting (Fig. 59). This achieved the safety of the wall, but owing to the impermeable nature of the apron the beach to the front was flattened some 18-ins.

The few types of wall illustrated in Fig 45 do not have, by their shape, any particular virtue excepting that of appearance. The type C, with a pronounced over-sailing coping is, however, one that should be avoided. The intention of the designer was to prevent the hurling of shingle to the back of the wall. In this connection it is remarkable how many people have the impression that shingle is projected upward following the path of the wall face. No doubt some particles do, but the explosion of the break throws water into the air from the back of the curler some distance from the wall, and with an on-shore wind the suspended material and the green water is deflected shorewards. Even heavily

Fig. 59. Vertical Mass Concrete Wall with toe apron.

Coast Protection—*continued*

curved copings are not fully effective, though they do diminish the amount of spill.

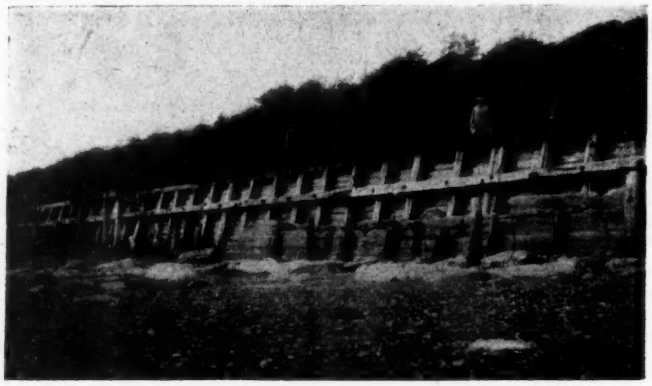


Fig. 60. Timber Sea Wall showing the remains of a Mass Concrete Wall in the foreground.

Fig. 61. Timber Sea Wall and Groyne.

There is one important point, viz., the line of a vertical wall should not be broken: access steps to the beach should always be within the line of wall and not jutting out from it. Bastions, common to Victorian built walls, should be eschewed; if any forward siting is necessary, it should be developed gradually by easy curves to the general run of the wall.

Given a plentiful supply of good timber, such as B.C. Douglas Fir, a sturdy, durable wall may be constructed rapidly at competitive cost. A good example is the wall fronting the West Cliff at Folkestone (Figs. 60 and 61). Uprights, ribands and stringers are of 12 x 12-in. section, backed with 10 x 3-in. sheeting. The uprights are about 6-ft. centres, the backfill is of gravel and clay, thoroughly sealed by a bitumen wearing course over the promenade deck. Repairs to such walls are comparatively easy, requiring little mechanical plant and less gruelling attention. The remains of an old battered concrete wall show in the right front of Fig. 60.

(To be continued)

Trade at the Port of Ardrossan.

During the year 1948, 1,999 vessels entered the Port of Ardrossan, 750,000 tons of cargo were imported or exported. The cargoes principally consisted of oil, scrap, steel and iron ore. Coal exports were negligible. Over 300,000 passengers to, or from Belfast, Isle of Man and Arran used the port during the year.

The mechanical Octopus grabs introduced by the management for the discharge of scrap cargoes have, with the working assistance of the Ardrossan dockers and cranemen, achieved a high standard equal to three times a speed at other ports where similar scrap cargoes are handled.

Cape Town Dry Docking Facilities

Extensively Used for Whaler Repairs

By ROBERT WILLS.

With the completion of the new docking towers, Table Bay Harbour has taken a further step forward in its endeavour to cope with the growing demand for dry docking facilities for whaling vessels. These steel towers will enable whalers to be berthed two abreast in the wide Sturrock dock. Concrete caissons, constructed for quay extensions, are at present serving as supports for the small ships. The inner basin of the dry dock is able to accommodate four whalers at a time.

Whalers under repair in the inner basin of the Sturrock dock are hemmed in by any big ship using the outer basin. With the placing of docking towers on rails in the outer basin, this difficulty will be overcome.

Catchers lying up at Cape Town mean a big thing to the city. It is estimated that £5,000 per ship is spent on repairs, while the boats are here during the off-season.

Thirty-seven whalers are wintering at Cape Town now. These thirty-seven boats represent five different companies, which include British, Norwegian, Russian and local interests, who have decided to winter at Cape Town in preference to the long voyage to Europe.

Deciding factors in choosing Table Bay as an off-season base are the high standard of repair work done here and the ability to obtain dry docking facilities. Equally important is the need to have the work finished in time for the opening of the whaling season, as time lost is money lost—an important consideration for firms who can only operate for six months a year.

Operating in the Antarctic for six months at a time, these sturdy little craft must be as near perfect as possible, thus the need for a complete overhaul during their stay at Cape Town. If anything should go wrong, there is no harbour where they can put into for repair.

It is estimated that a whaler can catch whales to the value of £4,000 per day, so if a major breakdown, such as the severing of a shaft, should occur, it means two ships out of action during the tow to Cape Town—a period of twenty days.

Thus the necessity for a complete overhaul, including hull and engine repairs, during the off-season, is a top priority with every whaling company.

Each whaler spends a fortnight in dry dock, where she is examined and all underwater repairs, such as replacing hull plates, attending to the rudder and screw, and painting below the water line, are carried out.

Internal jobs are done once the whaler has left the dry dock for its berth. Here the engines are examined, tested and repaired for the next season down south. Winches, harpoon gun and deck equipment come in for a thorough inspection.

The work of thoroughly overhauling the whalers from stem to stern is spread over the six months during which the ships are laid up; the emphasis being on the fact that the whalers must be ready to sail in October.

Cape Town is the major port in South Africa for whaler repairs. The whaling companies prefer to have all the boats they leave behind concentrated in one port for their annual overhaul. Last year, owing to local difficulties, a few whalers went to Durban.

Since whaling has become pelagic, Cape Town has done repair work on the catchers. More than twenty years ago the whalers operated from shore stations and had their bases at St. Georgia and in the Falklands.

With the advent of the factory ship, whaling has become more strenuous, as once the season opens there is no returning to base, as, in most cases, the factory ship has taken the place of the old shore establishments.

Experience gained over the years, particularly on big jobs during the recent war, enable Cape Town's engineering firms to compete with, and hold their own against any in the whaler repair trade.

Legal Aspects of Injuries at Work

Implications of Recent Legislation

By S. H. KESSELS

(concluded from page 231)

7. Statutory Requirements Affecting Docks

The statutory requirements as to safety of persons at work which most concern Dock and Harbour Authorities are those contained in the Factory Act, 1937, the Docks Regulations, 1934 (Statutory Rules and Orders, 1934, No. 279), and the Shipbuilding Regulations, 1931 (Statutory Rules and Orders, 1931, No. 133).

The Factory Act, 1937, has 160 sections, and schedules, all bearing on the safety and health of workers, and it is not proposed to list them in detail; but the following should be noted:—

Sections 105, 106 and 107 specially relate to Docks and Ships.

Section 105 sets out a list of those other sections (some 56) of the Act which apply to **Docks, Wharves and Quays,** including any line or siding used in connection with these and not forming part of a railway or tramway.

Many of these sections relate to records, penalties, interpretation and so on common to all "factories."

Regulations as to steam boilers are included, but the owner of the boiler is to be responsible.

This Section 105 also sets out a list of those other sections which apply to **Warehouses.** There are some 75 sections listed, but again many of these are common to other "factories." The most notable of the provisions concern fencing and cleaning of machinery; cranes, hoists and lifts, chains, ropes, tackle. Section 25 (one of those listed) deals with the construction and maintenance of floors, passages and stairs, the provision of handrails to stairways and the fencing of openings.

Section 106 applies to work carried on in ships in a harbour or wet dock, and lists a number of Sections that apply, but Regulations as to this work, which the Home Secretary may make by virtue of this Section and Section 60, have not yet been made (please see the paragraphs below on the Shipbuilding Regulations, 1931).

The Docks Regulations, 1934, concern all the "processes" of loading, unloading, moving and handling goods at docks, wharves and quays and also coaling. Some of the duties are placed exclusively upon the dock owners (Part 1 of the Regulations) and these deal, briefly speaking, with the fencing of approaches, quays, provision of first aid and life-saving apparatus and ambulances. The first aid regulations have been amended by those of 1937.

Quays are normally only fenced at the corners, breaks or specially dangerous places, as fencing along the straight edges would impede the work of loading and unloading (Regulation 1).

Part II lays duties on the owners of or officers in charge of ships as to means of access (gangways, ladders, etc.), hand and footholds in shaft tunnels, lighting, hatch-beam lifting gear and hatch covers.

Part III concerns all owners of machinery, such as cranes and derricks, and provides for periodic tests and examinations of these and the wires and ropes used in conjunction with them, safety devices and so on.

Parts IV, V and VI places duties on those carrying on the "processes," including the workmen employed, and deal with a miscellany of practices usual in a dock or on a ship loading or unloading. A print of these Regulations, that is convenient to read, must be exhibited on the working premises.

The Shipbuilding Regulations, 1931, apply to the construction and repair of ships in shipbuilding yards, and place duties on the "occupier," but where the ship is being repaired in public dry dock the repairing contractor becomes the "occupier" so far as concerns most of the duties. Part IX of the Regulations places duties on the men engaged.

The Regulations do not apply to ships under 150 feet long except for some of the Regulations relating to oil-tanks. The Regulations at large are divided into sections, as follows:—

- Part 1—Means of access.
- Part II—Staging.
- Part III—Precautions against injurious fumes and explosion.
- Part IV—Precautions against injury from falling materials.
- Part V—Lighting.
- Part VI—Training and supervision.
- Part VII—Ambulance.
- Part VIII—Miscellaneous.
- Part IX—Duties of persons employed.

These Regulations are really more the concern of ship-building or repairing contractors, or shipowners, and owners of public dry docks usually let them on hire to shipowners or repair contractors on terms including indemnity against claims for personal injury. It would seem that the Regulations do not apply to ships being repaired in public wet docks. The dock owner has virtually no control over repairs that may be done in a ship while at her berth in wet dock; and if the Regulations did apply, it would not be reasonable for him to be regarded as "occupier." The exact interpretation of "occupier" has been the subject of legal argument. In Lovell v. Blundells and another (60 T.L.R. at p. 326), it was held that the Regulations did not apply to a ship in wet dock; in Garcia v. Harland & Wolff, Ltd. (1943, 1 K.B. at p. 731), it was held that the ship repairers were not the "occupiers of a shipbuilding yard" if the work was being done in a wet dock.

Direct reference should, of course, be made to the Factory Act and the above mentioned Regulations.

8. Measure of Damages

The assessment of damages is based on an effort to make amends, as far as money can, for the sufferer's loss and his pain and suffering or loss of enjoyment of normal life. In a simple case, where the man lost, say, 10 weeks' work and recovered completely, if his medical expenses and loss of wages were £100 (the "special damage"), he might recover another £50 or £100 for pain and suffering ("general damages"). If he were totally or partially injured for life, the assessment of damages—depending on age, status, loss of future earnings and enjoyment of life—inevitably becomes vaguer, for the future can never be assessed precisely. There are no fixed rules, the assessment would rest entirely with the Court, and Court awards have varied considerably. For the loss of an eye, for instance, £500 was awarded in one case and £2,000 in another.

The reader is referred to the part numbered 9 ("Further Recent Changes, etc.") for information as to deductions in respect of national insurance that may be made from claims for damages.

Prior to the first of the Fatal Accidents Acts, 1846 to 1908 (the first being known as Lord Campbell's Act), the legal right to damages of a person killed in an accident due to someone's negligence or breach, died with him (a dead person could not be a plaintiff), but those Acts authorise the executor or administrator of the deceased to sue the wrongdoer, on behalf of certain dependants, for the loss of the support they might have had in the future from the deceased. Any benefit that the dependants may get by way of insurance that the deceased had taken out is **not** to be deducted from the damages awarded.

The Law Reform (Miscellaneous Provisions) Act, 1934, entitles the estate of the deceased (in fatal cases) to receive something in addition for his "loss of expectation and enjoyment of life." As it has been said in Court, "it is assumed that continuance of life is a thing worth having." The sums awarded under this head are often considerable, but there is an important qualification. These sums are not payable in addition to those payable under the Fatal Accidents Acts if the persons who benefit from the estate are the same as the dependants who benefit under the Fatal Accidents Acts—and they often are the same if the deceased died without having made a will. In such cases of identity of the persons who benefit, whichever if the greater sum is in effect deemed to absorb the lesser.

It might be thought that the remarks already made (in Part 4) on the dubious principle of lump sum settlements could also be

Legal Aspects of Injuries at Work—*continued*

applied to the payment of lump sums by way of damages. Sometimes they could, but it has to be accepted that the law has from time immemorial awarded lump sum damages against the wrongdoer, and not weekly sums. It is no doubt a survival of the first practice of substitution of payment in money or kind as retribution for injury in place of the more ancient and barbarious tribal practice of "an eye for an eye."

9. Further Recent Changes—Law Reform (Personal Injuries) Act, 1948

The Law Reform (Personal Injuries) Act, 1948, based on the recommendations of the Committee on Alternate Remedies (under the Chairmanship of Sir Walter Monckton, K.C.) has made radical changes.

The first, and slighter, one is that the Employers' Liability Act, 1880, is abolished, but the only material effects of this abolition are that damages claims are not limited in sum to three years' wages, and the time limit of six months (for proceedings) no longer operates.

The second change is that acceptance of weekly benefit from the State under the National Insurance (Industrial Injuries) Act, 1946, or of State sick pay, does not in any way bar a man from making a claim for damages, if he is otherwise entitled to do so. He does not, as under the previous workmen's compensation law, have to "elect" to take one or the other. Of the moneys received as industrial injury benefits, only one half need be set off against damages to reduce the latter by that amount; and if the incapacity is likely to be of long standing, the maximum reduction is limited to one half of five years' benefit. If, however, an action is brought under the Fatal Accidents Acts, or the Carriage by Air Act, 1932, State benefits payable are not to be set off at all against the damages.

This separation, and keeping alive, of the two forms of remedy, is based on the view that the State benefit is something for which the man has insured himself (at least, as regards about one half of it, his proportion of the weekly contribution); and on the contention that an employee, merely because he is an employee, cannot be deprived of the right to claim damages that every private citizen may have.

As there is no question of "election" to take one of alternate remedies, there is no effective time limit, after the accident, in which a man may claim damages—except the limit of one year in the case of Public Authorities, such as statutory Dock Companies (Public Authorities Protection Act. 1893, and Limitation Act, 1939), or six years in the case of private bodies or persons (Limitation Act, 1939). Employers who have to investigate claims that arose months beforehand may be gravely handicapped in assessing the facts.

The third and perhaps most vital change is the abolition of the defence of common employment. As an employer is, and always has been, liable for the wrongful acts of his employees (see the Part numbered 3 on "Negligence"), he now has no defence to a claim by his own employee for damages for personal injury caused by the negligence of another one of his employees.

A great many operations in a dock are, of course, joint ones. If several men are moving a case and it falls on the foot of one of them, it is easy to allege negligence on the part of the others and very hard to rebut, so the employer becomes liable.

Almost the only exception, or part exception, to an employer's liability may be the negligence or contributory negligence of the injured person, if that occurred. Of this, more will be said in the next Part (numbered 10 and headed "Defence of Contributory Negligence, etc."). Virtually the only defences the employers may have left are set out in this next Part.

10. Defence (to claims for damages) of Contributory Negligence, etc.

A defendant, although he has been negligent in some way, may still not be liable (or at least, not fully liable) if the injury was directly and materially contributed to by the negligence of the injured person.

Negligence or contributory negligence of the injured person once acted as a complete bar to his claim, if that negligence was the real and efficient cause of the accident. Since, however, the Law Reform (Contributory Negligence) Act, 1945, if damage is caused partly by the negligence of the plaintiff as well as of the defendant, the Court may only **diminish** the damages, in such proportion as it thinks fit. Contributory negligence has now to be of a high degree— in fact, it must be the true cause of the accident if it is to bar the plaintiff altogether.

A plaintiff is expected to behave like a reasonable person and to exercise the caution required of the circumstances. He is not supposed to walk into obvious danger; and a disregard of a warning notice would emphasise his contributory negligence. For instance, if a dock worker injures himself, in daylight, by falling over a mooring rope lying across the quay, he would have great difficulty in recovering damages, because the quays (which are not in the same category as highways) are normally obstructed by ropes, cargo and so on, and there is a duty on the persons using them to be vigilant.

In estimating whether the real and efficient cause of an accident was the negligence of the defendant or the plaintiff, a deciding factor may be what was the final cause, who by doing one thing or another, had the last chance of avoiding the accident.

An act done at the last moment by the injured person in stress of grave threatening danger would probably not be regarded as negligence. If, for example, a man, seeing something about to fall on him, jumps away in fright, falls in the dock water and is drowned, he would not be considered negligent, although he might, if calmer, have jumped to safety in another direction.

Contributory negligence may also be a defence to a claim based on breach of statutory duty, although the point is not free from doubt. The Court of Appeal, in the case of Dew v. United British Steamship Co. (1929) held that contributory negligence in that case prevented the plaintiff from succeeding. The plaintiff, a coal trimmer, fell down the open and unfenced hatchway of a ship on which he was working, and he was said to have been negligent in not taking due precaution, knowing of the open hatch.

It is generally considered that the duty to fence dangerous machinery is absolute.

It is difficult to defend a claim on behalf of an injured child (unless the child were trespassing), because a child is not expected to behave in the careful manner of an adult.

The defence of "inevitable accident" is a difficult one. The term means something that could not be prevented by reasonable care, caution and skill. During the case of **Rylands v. Fletcher** (1868), it was said that persons who, by the licence of the owner, pass near to warehouses where goods are being raised or lowered, do so subject to the inevitable risk of accident. But to use this argument as a defence, there must be inevitable and unavoidable accident, and not mere negligence.

"Act of God" may also be a defence, but rarely. It means violent and unpredictable acts of nature that cannot reasonably be guarded against. A sudden whirlwind of unusual force, set up by a storm, that sweeps a man off the deck of a ship into the hold, might come within such a category.

There is also the class of defence of "acceptance of the risk" (*volenti non fit injuria*). Thus a demolition worker may be said to have accepted the extra dangers of his work.

One who volunteers to rescue another endangered by a third party's negligence, and is injured during the attempt, can, however, succeed against the third party, because the volunteer acted reasonably; nor does the defence of "acceptance of the risk" apply where there is a clear breach of statutory duty.

. . . . . .

Employers now have to meet many claims for which they are legally but not morally responsible. As was said during the investigations of the Monckton Committee, an employer or his manager cannot effectively control the actions of his employees moment by moment.

During the past century the wheel has turned full circle, and the liability for State contributions plus damages for personal injuries (in so large a proportion of accident cases) has become a considerable burden on industry.

Tidal Features of Southampton Water

Investigation into Cause of Remarkable Phenomena

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If, as has been anciently observed, tidal behaviour is "the grave of human curiosity," it must surely follow that Southampton Water is a veritable graveyard of discredited speculations concerning the origin and cause of the remarkable phenomena occurring at that place.

Within the last quarter of a century a very close investigation of world-wide tidal data has been conducted by Dr. A. T. Doodson, F.R.S., and his colleagues of the Liverpool Tidal Institute, using all the critical apparatus now made available by the immense advances in physical science and their elucidation by newer and more precise mathematical techniques and analyses.

The practical result of this most necessary and valuable research has been to consign many former hypotheses concerning the British tides to the academic dust-bin. In consequence, many fondly held theories of varying degrees of plausibility concerning the remarkable double-day tides in Southampton Water have received the coup-de-grace.

Prior to any discussion, it may be advantageous to describe a typical Spring curve for Southampton, recorded by the Town Quay automatic gauge at the port, the datum of reference being in fact 6.75 feet below Ordnance Datum (Liverpool) or alternatively 7.48 feet below Ordnance (Newlyn), which level is known locally as Port Low Water Datum — abbreviated P.L.W.D. (See Fig. 1.)

The main features of such a curve are as follows (see Fig. 2, which includes Neap curves):—

(1) The most acute bend in the Spring curve is that occurring at Low Water, which incidentally is well defined. The time and level of Low Water are accordingly good data of reference for the compilation of "reduction tables" for intermediate levels near Low Water to determine clearances for deep draught ships. (See below.)

(2) From Low Water the levels rise sharply for about 1½ hours from Low Water, subsequently changing to a slow rise until about 4 hours after Low Water. Several circumstances, including local and remote weather conditions, may combine to modify this slow rise (known locally as the "Young Flood"), to include a perfectly flat 1 hour stand or sometimes even a slight fall of about 6 inches. (See Figs. 2 and 3.)

(3) From 4 hours after Low Water the rise in level now becomes increasingly swift, attaining a maximum of about 1 inch per minute 5 hours after L.W. at the Town Quay. The rise begins to ease off at about 6 hours after L.W. (or three-quarters of an hour before the First High Water).

(4) First High Water occurs 6½-6¾ hours after Low Water. It is generally, but not always, higher than the Second High Water, which makes about 1¾ hours later, and at Springs a slight intermediate fall in level intervenes between the two High Water.

(5) Meteorological conditions, local and remote, can modify the combined shape and duration of the two High Water features considerably, e.g., one perhaps completely eclipsing the other, sometimes a combined rounded "single High Water" curve, or very occasionally a long flat stand of 3 to 4 hours duration in times of long prevailing gales around the British Isles. (See Fig. 3.)

(6) From the time of Second High Water, levels fall very rapidly, and Low Water occurs nearly 4 hours later. During this ebb period, the most rapid alteration in levels throughout the entire curve occurs between 2 and 3 hours after Second High Water, the rate of fall being then about 1.3 inches per minute.

(7) In relating the direction and rate of the Tidal Streams above Calshot to the Town Quay curve of levels, it is roughly true to say that for the mid-channel axis from Hythe to the docks a rise or fall in level is in phase with upstream or downstream tidal flow respectively. As the tidal section above Calshot to the docks is very roughly uniform, the direction of the axial stream in the deep-water section will be found to be in phase with, and directly proportional in rate to movement in vertical levels read from a gauge set adjacent to the site of measurement. (See Table "A" on next page.)

(8) It is interesting to note that near Calshot Castle the times of High and Low Water (and a rather less pronounced Young Flood) are normally 5 minutes later than their occurrence at the Town Quay, although, of course, absolute intermediate levels in Flood Ebb will vary considerably for short periods.

(9) It is important also to remember that outside Calshot, i.e., at the Calshot Light Vessel and in the Western approach channel the tidal streams are not in phase with the rise, culmination, or fall in tidal levels at or above Calshot Castle.

For example, the West-going stream off the West Bramble buoy makes (after a 20-minute slack) 1½ hours before First High Water at Calshot and the Town Quay, whilst levels are still rising. This is due to the fact that, at such stations, the dominant tidal flow of the Solent prevails. (See Table "B" on next page.)

The direction and strength of the tidal streams in the Solent proper are determined roughly by the levels prevailing at the Nab and Needles respectively, or more precisely at the Eastern and Western entrances to the Solent "channel".

As the Nab range is almost double that at the Needles and H.W. and L.W. times are very approximately simultaneous, tidal flow through the Solent will be westward at H.W. times and eastwards at L.W. (Fig. 4 shows simultaneous tidal curves related to Ordnance Mean Sea Level Datum and roughly illustrates the principles of hydraulic flow in the Solent.)

Having now briefly described the outstanding features of Southampton tidal data, it will be clear to the reader that the port is provided with enormous tidal advantages for the development of terminal facilities in respect to the largest and deepest draught ships of our times.

Provided that such ships do not draw more than 40 feet, it is clear that a channel dredged to 38 feet below Port Low Water Datum, for example, would actually accommodate such ships with an adequate hydraulic clearance under their keels, from the time of the commencement of the Young Flood until about one hour after the occurrence of the Second High Water following, a continuous period of nearly 10 hours covering, in fact, 75% of the tidal cycle. If berthing conditions are to be considered, 1 hour should be deducted to cover a small flood period when tidal streams are strong, and the main ebb period of 3 hours disregarded.

Incidentally, it is a wise and venerable axiom in this area that ship operations with close depth margins cannot without presumption be planned on the ebb tide between 1 hour after Second High Water and the succeeding Low Water, as rates of falling levels and tidal streams are then at maxima.

In considering the remarkable tidal features as set out above, and illustrated in Fig. 2, it is obvious that from the time of the Phoenicians and subsequent Celtic invasions during the first Millennium B.C., the valuable shelter of the Isle of Wight and long periods of slack water at the tidal stands in Southampton Water must have evoked much admiration and curiosity.

Tidal Features of Southampton Water—continued

The Romans, who called the area Portus Magnus, must have regarded matters from the same standpoint, in view of the rather terrifying tidal disasters experienced during their first attempt at invasion off Dover. (See Note " A ".)

The first specific description of the Double High Waters I can discover is that by the Venerable Bede in the 7th Century A.D., which stands as follows in his description of the Isle of Wight:—

> " The island is situated opposite the division between the South Saxons and the Gewissæ, being separated from it by a sea three miles over which is called Solente. In this narrow sea the two tides of the ocean, which flow round Britain from the immense northern ocean, daily meet and oppose one another beyond the mouth of the River Homelea (Hamble), which runs in to that narrow sea from the lands of the Jutes, which belong to the country of the Gewissæ; after their meeting and struggling together of the two seas, they return in to the ocean from whence they came."

In Camdens " Brittannia " (1695), the following statement is recorded:—

> " From Winchester . . . the River Hamble out of a large mouth runs into the sea. Bede calls is Homelea and says it runs through the country of the Jutes, and falls into the Solent. For so he calls the channel running between Britain and the Isle of Wight, into which at certain hours two opposite tides coming up with great violence from the ocean and meeting here, raised so great an admiration in our forefathers that they reckoned it one of the wonders of Britain." (See Note " B ".)

This remarkable and venerable statement appears to show that well over 1,200 years ago the double high water phenomena at Southampton had been well noted and that the most enlightened contemporary opinion had even then moved away from any idea that this was caused solely by the existence of the Isle of Wight.

It is even possible that the famous tale about King Canute was occasioned by an attempt at flattery on the part of a judicious courtier, who had naively noted the recession of the tide after the First High Water, but had not consulted local seamen about the existence and nature of the Second!

In any case, it was not until the principles of universal gravitation enunciated by the great Newton were re-applied to tidal theory in the later 19th and early 20th centuries that somewhat confusing, if plausible and " cut and dried " theories, by many famous and excellent men and scientific groups began to agitate over the tidal curiosities at Southampton.

The common canard to the effect that the Isle of Wight is the real and sole cause of local tidal features is neither ancient nor even feasible, as similar double day tides, or long stands, occur at Havre and Honfleur on the French coast (as shown in Fig. 5).

A more intelligible " lay " explanation is that the First High Water at Southampton is caused by the Atlantic tidal wave arriving directly up the English Channel, while the Second High Water is the result of an earlier wave which is believed to have travelled " North about " through the North Sea, " inter-penetrating " the first wave at Dover and reaching Southampton in time for the Second High Water.

It was assumed by the advocates of this theory that tidal waves could, like ripples on a pond, pass through each other without serious change and act independently of each other.

This view, which has been uncritically accepted by a number of eminent persons in the past (including apparently the Venerable Bede) is regarded as completely untenable by modern tidal experts, who point out that opposing waves, if they in fact existed as the theory requires, would not act independently of each other, as was assumed, but would combine in a resultant curve, which is not found at Southampton.

The " opposing waves " theory has been stated in the now obsolete edition of the " Admiralty Manual of Navigation," published in 1914, but is not now accepted in any scientific quarter.

A number of similar " explanations " combining the above ideas and adding other features (such as " waves reflected from the French coast ") have cropped up from time to time, but it is quite obvious from the researches of Dr. T. A. Doodson and others of the Liverpool Tidal Institute that no " simple " explanation, which aims at the visualisation of crude hydraulic mass movements in the tidal waters of the English Channel, has any hope of doing justice to the Southampton phenomena.

Very extensive observations for levels multiplied over a wide adjacent area, including sites remote from the shore, would have to be made for long periods before mathematical analysis could hope to elaborate a full account of the origins of local tidal features.

This does not, of course, mean that the astronomical tide at Southampton cannot

Table A (left)

Table B (right)

DOCK APPROACHES OFF HYTHE PIER—TIDAL STREAMS AT —074°—1300′ from Light Standard (Hythe Pier).

Hours from L.W., Town Quay.			Set. True.	Rate.		Remarks.
				Sp.	Np.	
Before L.W. (Town Quay)	Ebb	6	323°	0·5	0·3	First High Water (Town Quay) 5¼H before L.W.
		5	089°	0·1	0·0	
		4	Slack	0·0	0·0	Second High Water (Town Quay) —20M. slack
		3	113°	0·3	0·2	
		2	131°	1·1	0·6	
		1	134°	1·9	0·9	Maximum ebb stream
L.W.		0	129°	0·3	0·2	
After L.W. (Town Quay)	Young Flood	1	325°	0·7	0·4	
		2	332°	0·6	0·3	
		3	353°	0·3	0·2	
	Flood	4	Slack	0·0	0·0	20M. " slack" period
		5	323°	1·1	0·6	Maximum flood stream
		6	321°	0·9	0·5	
		7	Slack	0·0	0·0	20M. after First High Water

In the Middle and Lower Swinging Grounds the rates are ¼ to ½ knot less than those given in the above table, but their directions are sometimes confused and eddying, which fact is of importance in the handling of ships in these areas.

N.B.—Strong NE or SW winds will modify these rates.

Table (A). Tidal Streams off Hythe.

WESTERN APPROACH.

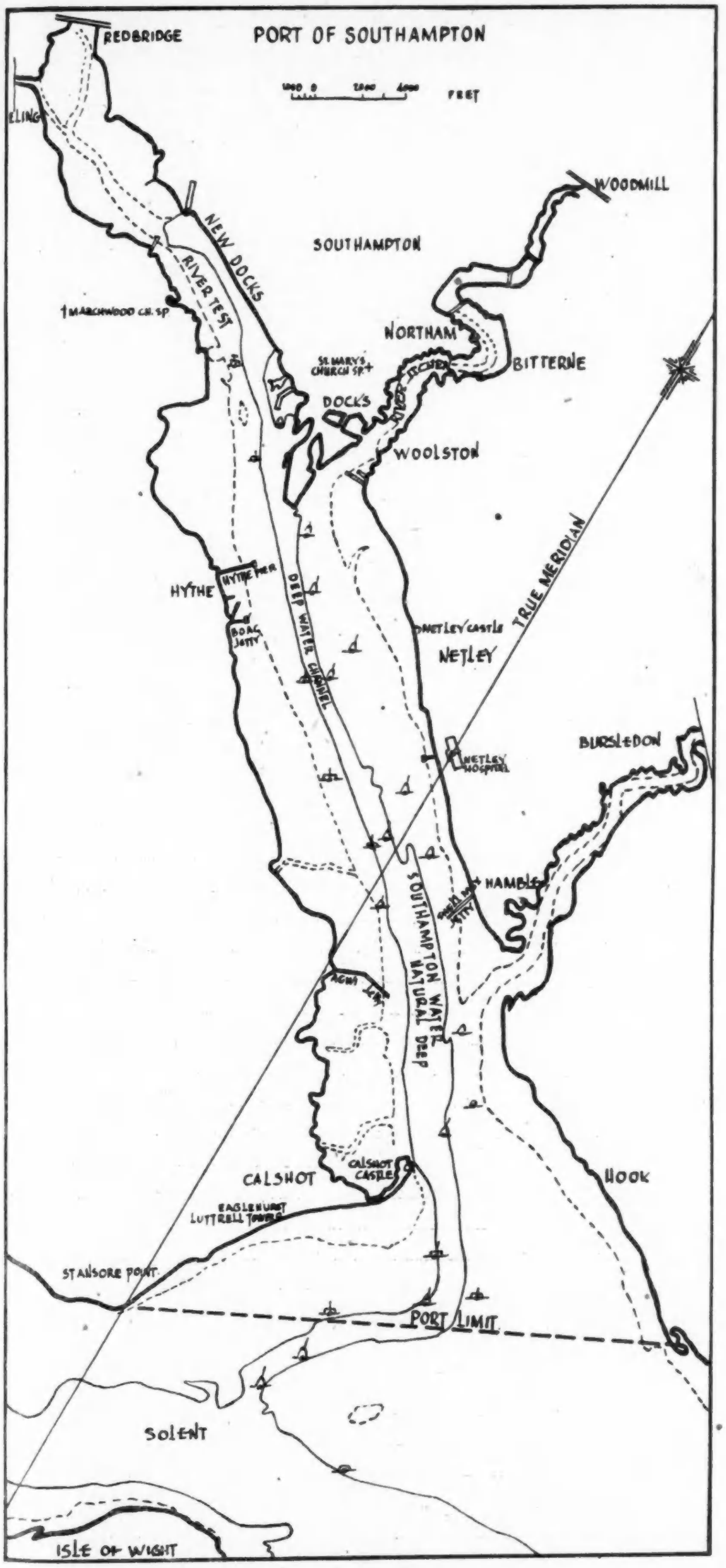
TIDAL STREAMS AT (A) — 174°—7000′ from Eaglehurst F.S.

Hours from L.W., Town Quay.		Set. True.	Rate.		Remarks. (Governing Thorn Channel).
			Sp.	Np.	
Before L.W. (Town Quay)	6	223°	0·8	0·4	First High Water (Town Quay)
	5	231°	2·1	1·0	
	4	236°	1·8	0·9	Second High Water (Town Quay)
	3	231°	1·7	0·8	
	2	230°	1·4	0·6	
	1	226°	0·9	0·4	
L.W.	0	Turning	0·0	0·0	20M. " slack " period before East-going stream
After L.W. (Town Quay)	1	057°	1·1	0·5	
	2	057°	1·0	0·5	
	3	055°	1·0	0·5	
	4	055°	1·3	0·7	Maximum East-going rate
	5	044°	1·0	0·5	
	6	223°	0·2	0·1	5M. " slack " period before West-going stream
	6½	223°	0·8	0·4	First High Water (Town Quay)

Table (B). Tidal Streams outside Calshot.

Note A. Julius Cæsar (100-44 B.C.) in his account of his first expedition to Britain, describes how, having hauled up his ships at neaps, and having no knowledge of the increase in the height of the tide at springs, many of his ships were damaged or lost at full moon.

Note B. Bede (A.D. 672-735) connects the tides with the moon, gives some account of the phase inequality, and mentions the fact that on the eastern coast of Britain high water is earlier in the north than in the south.



Approaches to Port of Southampton.

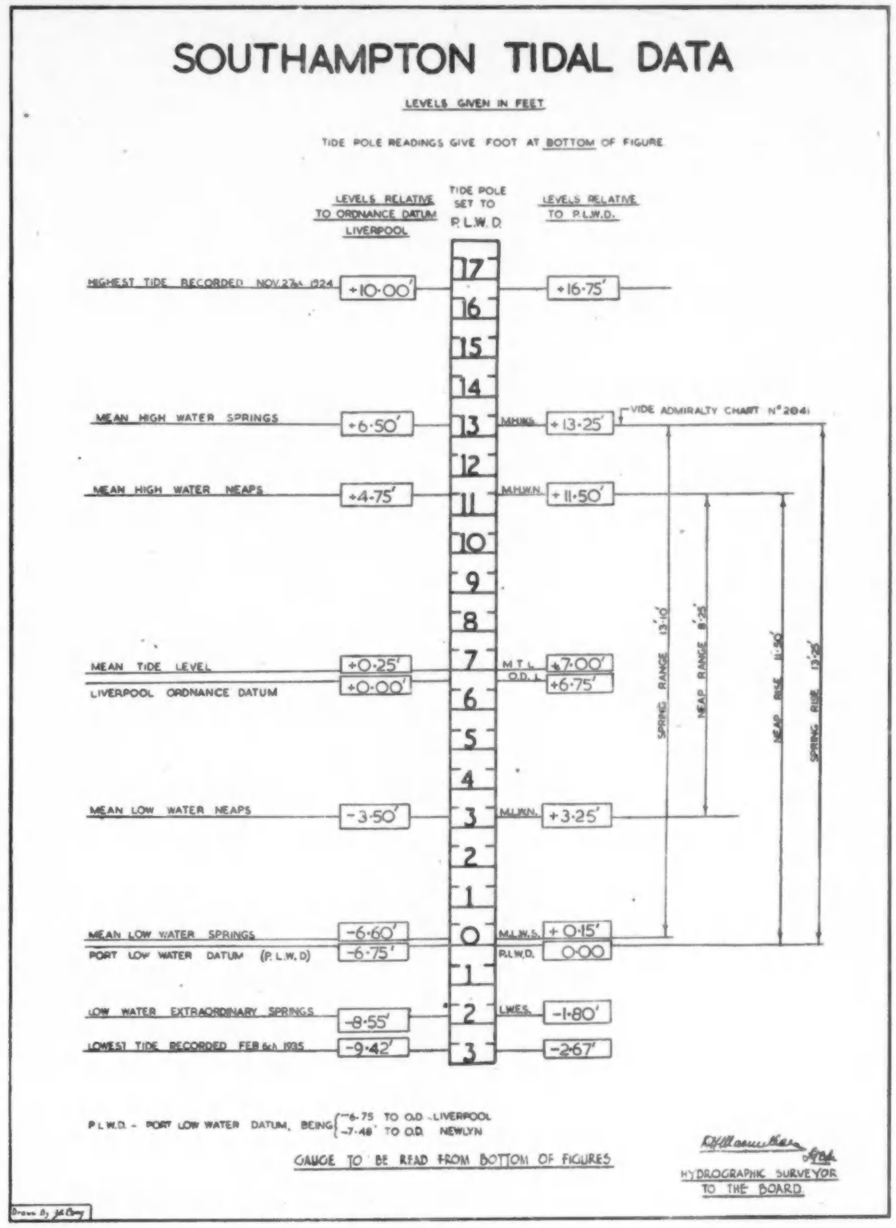


Fig. 1.

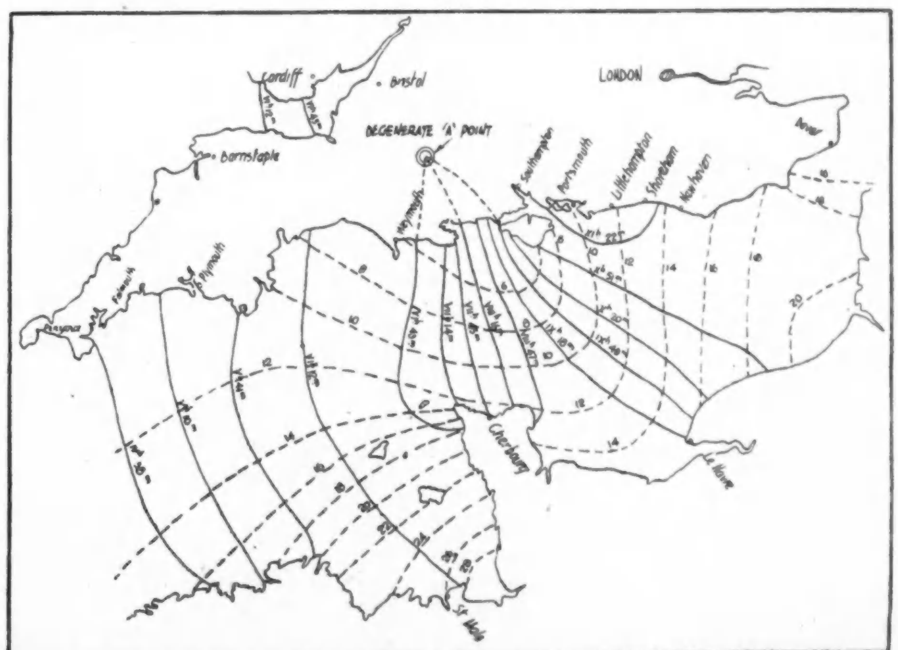


Fig. 6. Diagram showing Co-Tidal and Co-Ra ge Lines Indicating Degenerate Amphidromic Point. Lunitidal Intervals and Ranges are given.

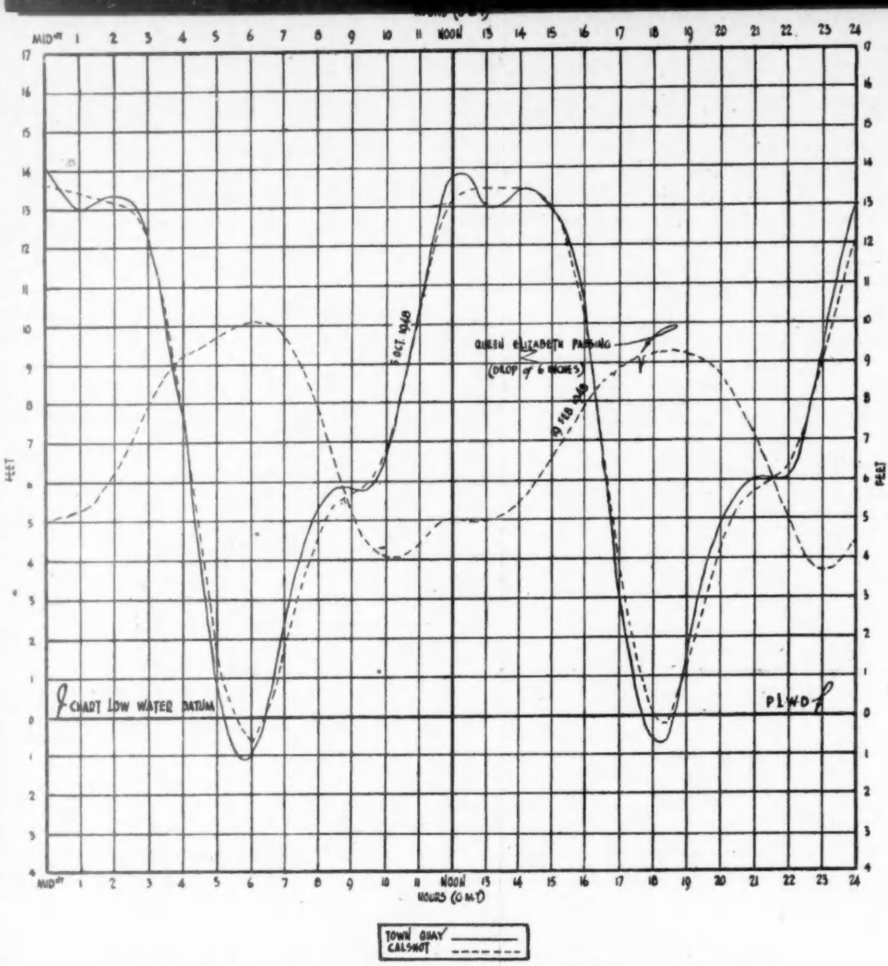


Fig. 2. *Port of Southampton.* Typical Spring Tidal Curves at Town Quay and Calshot also Neap Curve at Calshot showing effect of Queen Elizabeth passing.

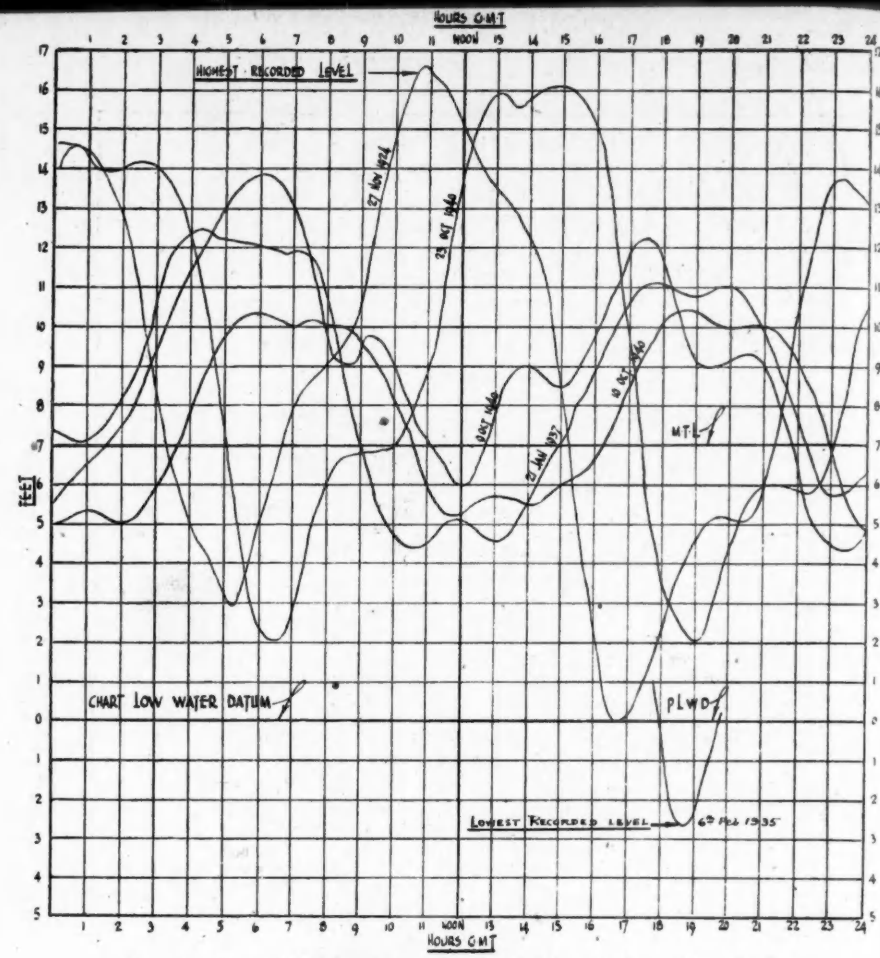


Fig. 3. *Port of Southampton.* Abnormal tides at Town Quay due to Meteorological Disturbances.

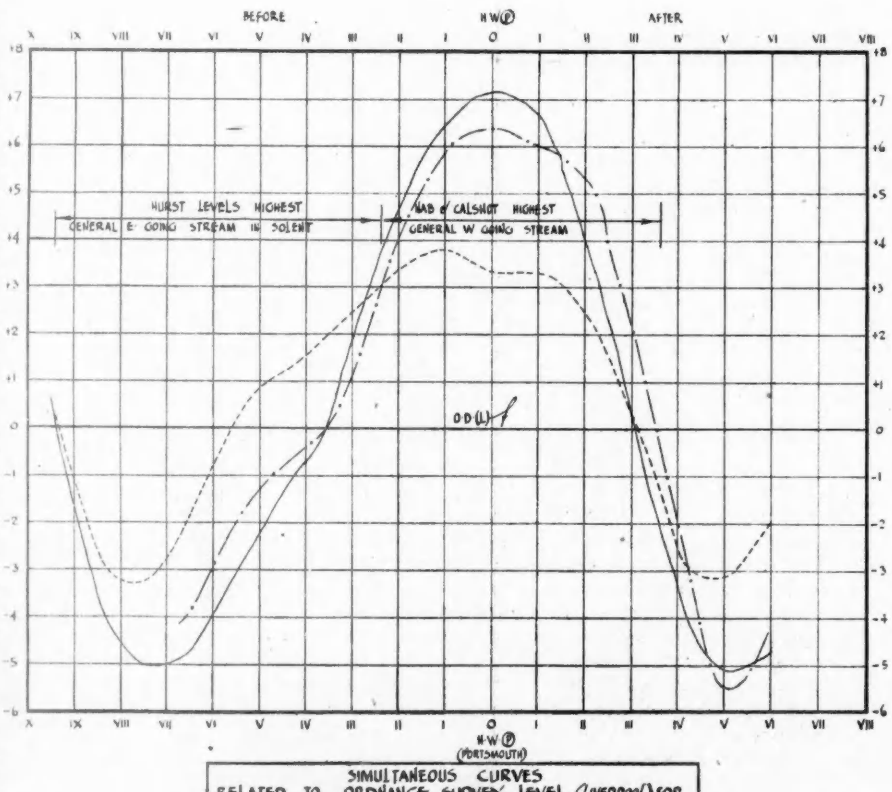


Fig. 4. Predicted Solent Curves Related to time of H. W. Portsmouth.

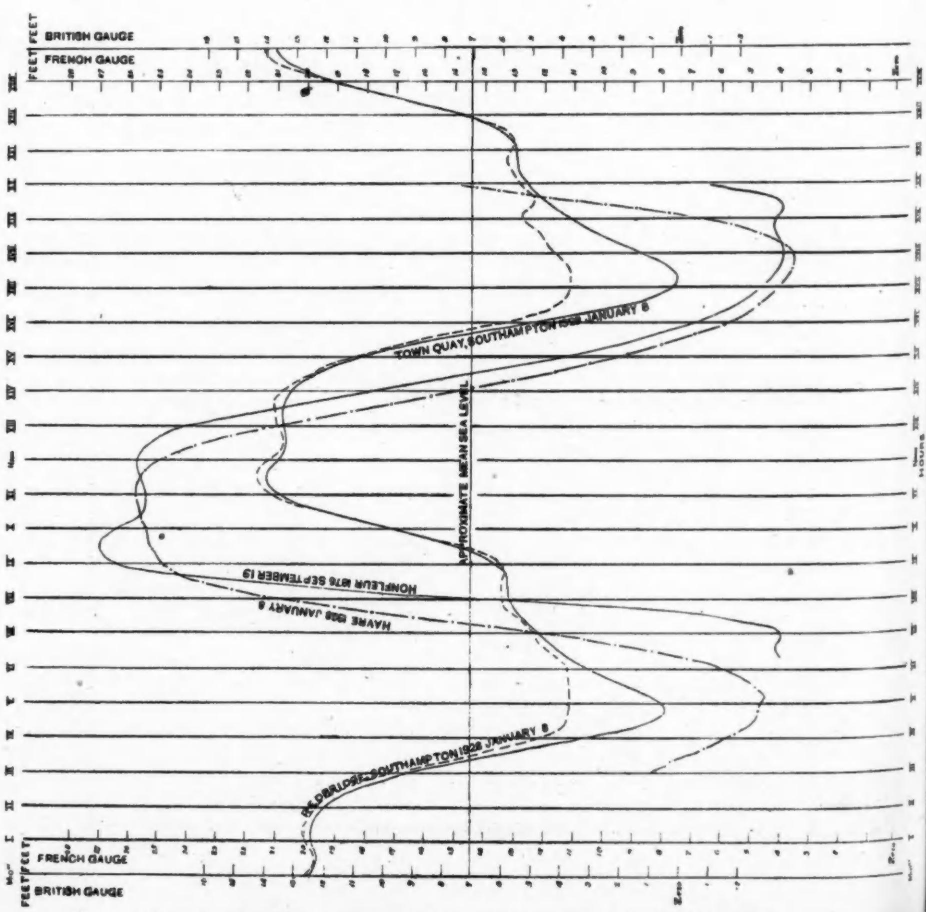


Fig. 5. Hornfleur and Havre curves compared with Southampton.

Tidal Features of Southampton Water—continued

be precisely computed. The results at Southampton are of very great accuracy, both for level and timing, and local Authorities, navigators and engineers are highly satisfied with the notable achievements of the Liverpool Tidal Institute in this respect.

Researches which have revolutionised tidal science have been proceeding during the last quarter of a century, and it appears to be true to-day that the old "classroom" equilibrium theory of the tides in general, dear to the heart of school-masters, has now been superseded by a more precise dynamical conception which is not content with the older static theory according to which the sun and moon's masses merely raise "lumps" in an "ideal" ocean, through which points on the earth's surface conveniently rotate.

In this connection, it should be noted that the tides in the English Channel (in the absence of the earth's gyration) could be considered as standing oscillations with a node across the channel from the Isle of Wight. Such a line would be modified by the effect of the earth's rotation to produce an amphidromic point, but in actuality, probably owing to friction, the amphidromic system is degenerate, that is, the point is virtually on the land, although the cotidal lines roughly radiate from it. The diagram showing cotidal lines for the English Channel illustrates how these radiate from a point north-west of the Isle of Wight. (See Fig. 6.)

Under such circumstances, the range of tide decreases towards the amphidromic point, and thus we see that the places at Southampton in the simplest manner, but for some obscure reason, in actuality, the phase relations mentioned are greatly changed at Southampton, and actually we have to look for more complex reasons for the explanation of the double high waters. That is, the existence of the Isle of Wight hinders rather than facilitates the production of double high waters.

An analysis of the tidal curve at Southampton, with its salient harmonic constituents, shows it is the "sixth" diurnal shallow-water tide that accounts for the flattening out of the tidal curve at High Water and also brings out the "halt" near the half tide of Young Flood.

The higher species of shallow-water (tenth diurnal and above) must be brought in to give a really close approximation to

NOVEMBER, 1948.

		First High Water.		Second High Water.		Low Water.		Tide Letter.	
		Time.	Ht.	Time.	Ht.	Time.	Ht.	Ebb.	Flood.
		H. M.	F.	H. M.	F.	H. M.	F.		
1	M.	10 31	14·5	00 02	13·3	04 03	*0·5	T	X
		22 51	14·0	12 25	14·1	16 28	*0·6	W	W
2	Tu.	11 10	14·4	00 48	13·6	04 50	*0·7	V	X
		23 31	14·1	13 09	14·0	17 10	*0·8	W	X
3	W.	11 49	14·1	01 31	13·7	05 31	*0·4	V	W
		—	—	13 50	13·9	17 50	*0·5	S	W
4	Th.	00 14	13·8	02 16	13·5	06 07	0·2	S	V
		12 28	13·6	14 29	13·4	18 25	0·1	S	T
5	F.	00 56	13·1	02 55	13·0	06 46	1·0	Q	S
		13 10	12·8	15 07	12·8	18 58	1·2	P	P
6	Sat.	01 44	12·3	03 38	12·3	07 20	2·3	M	O
		13 54	11·9	15 43	12·0	19 36	2·3	L	L
7	Sun.	02 36	11·5	04 20	11·6	08 01	3·7	H	K
		14 46	10·9	16 24	11·1	20 19	3·5	G	F
8	M.	03 39	10·5	05 13	10·7	08 54	5·0	C	F
		15 45	10·1	17 15	10·3	21 21	4·7	C	B
9	Tu.	04 58	10·0	06 23	10·1	10 11	5·7	A	B
		17 06	9·6	18 29	9·7	22 46	5·4	A	A
10	W.	06 24	10·1	07 46	10·1	11 39	5·8	B	B
		18 33	9·6	19 56	9·7	—	—	A	A
11	Th.	07 35	10·5	08 58	10·4	00 12	5·2	B	B
		19 42	10·1	21 08	10·1	12 51	5·2	C	B
12	F.	08 25	11·1	09 52	10·9	01 19	4·4	E	E
		20 31	11·0	22 00	10·8	13 45	4·3	F	E
13	Sat.	09 01	11·8	10 32	11·6	02 05	3·6	J	H
		21 11	11·6	22 45	11·4	14 26	3·1	J	J
14	Sun.	09 34	12·5	11 11	12·2	02 42	2·6	M	M
		21 43	12·3	23 22	12·0	15 00	2·2	M	M
15	M.	10 02	13·0	11 43	12·7	03 14	1·8	O	O
		22 16	12·7	—	—	15 33	1·3	O	P

GREENWICH MEAN TIME.
* Fall below Datum.

TOWN QUAY REDUCTION TABLE.
(Heights in feet and decimals **above Low Water, Town Quay.**)
TIDE LETTER FOR DAY (FROM TABLES).

Time from L.W.		A	B	C	D	E	F	G	H	J	K	L	M
Before low water :													
3½ hours		4·0	5·0	5·5	5·8	6·3	6·8	7·3	7·8	8·3	8·7	9·3	9·7
3 hours		3·8	4·8	5·2	5·3	5·5	6·0	6·7	7·4	7·9	8·4	8·9	9·4
2½ hours		3·5	4·2	4·3	4·6	5·0	5·3	5·7	6·4	6·8	7·4	7·9	8·5
2 hours		2·9	3·3	3·4	3·5	3·8	4·1	4·5	4·9	5·4	5·9	6·3	6·8
1½ hours		1·8	1·9	2·0	2·3	2·5	2·7	2·8	3·3	3·6	3·9	4·2	4·6
1 hour		0·8	0·8	0·8	1·0	1·0	1·2	1·3	1·4	1·6	1·7	2·0	2·3
0½ hour		0·3	0·3	0·3	0·3	0·3	0·3	0·3	0·4	0·4	0·4	0·4	0·4
Low water		0·0	0·0	0·0	0·0	0·0	0·0	0·0	0·0	0·0	0·0	0·0	0·0
After low water :													
0½ hour		0·2	0·1	0·1	0·2	0·2	0·2	0·2	0·3	0·3	0·4	0·4	0·5
1 hour		0·3	0·4	0·4	0·5	0·6	0·7	0·7	0·8	0·8	1·0	1·1	1·3
1½ hours ...		0·6	0·7	0·8	0·8	0·9	1·0	1·2	1·3	1·5	1·7	1·8	2·0
2 hours ...	Young Flood	0·7	0·8	0·8	0·9	1·0	1·1	1·3	1·6	1·7	2·0	2·5	2·8
2½ hours ...		0·8	0·9	0·9	1·0	1·1	1·2	1·5	1·7	1·9	2·6	2·8	3·2
3 hours ...		1·0	1·1	1·2	1·2	1·3	1·5	1·7	1·8	2·1	2·9	3·1	3·6
3½ hours ...		1·2	1·5	1·5	1·6	1·7	1·9	2·0	2·2	2·8	3·3	3·6	3·9
4 hours ...		1·5	1·7	1·8	1·8	1·9	2·0	2·4	2·9	3·3	3·6	3·9	4·2
4½ hours		1·7	1·9	2·0	2·2	2·4	2·7	3·0	3·3	3·7	4·0	4·3	4·7
5 hours		2·3	2·6	2·7	2·9	3·2	3·5	3·9	4·4	5·0	5·4	5·8	6·2
5½ hours		2·9	3·6	3·8	3·9	4·2	4·6	5·0	5·5	6·0	6·5	7·0	7·6
6 hours		3·2	3·9	4·4	4·6	5·4	6·0	6·6	7·1	7·7	8·1	8·6	9·1
6½ hours		3·7	4·4	4·9	5·5	6·0	6·7	7·2	7·7	8·2	8·8	9·3	9·8

Time from L.W.		N	O	P	Q	R	S	T	V	W	X	Y
Before low water :												
3½ hours ...		10·2	10·7	11·2	11·7	12·2	12·7	13·3	13·8	14·3	14·8	15·3
3 hours ...		9·9	10·4	10·9	11·4	11·9	12·3	12·8	13·3	13·8	14·2	14·7
2½ hours ...		9·0	9·5	10·0	10·5	10·9	11·4	11·8	12·2	12·7	13·1	13·5
2 hours ...		7·3	7·7	8·1	8·5	8·9	9·3	9·7	10·1	10·5	10·9	11·3
1½ hours ...		4·8	5·1	5·4	5·7	6·0	6·3	6·6	6·9	7·2	7·4	7·7
1 hour ...		2·5	2·8	3·0	3·1	3·3	3·4	3·6	3·7	3·8	4·0	4·1
0½ hour ...		0·5	0·5	0·6	0·7	0·8	0·9	1·0	1·1	1·1	1·2	1·3
Low water ...		0·0	0·0	0·0	0·0	0·0	0·0	0·0	0·0	0·0	0·0	0·0
After low water :												
0½ hour ...		0·5	0·6	0·6	0·7	0·8	0·9	0·9	0·9	0·9	0·9	1·0
1 hour ...		1·5	1·6	1·8	1·9	2·2	2·2	2·3	2·4	2·6	2·7	2·8
1½ hours ...		2·3	2·5	2·8	3·0	3·2	3·4	3·6	3·8	4·0	4·3	4·5
2 hours	Young Flood	3·0	3·3	3·7	3·9	4·1	4·3	4·5	4·9	5·2	5·4	5·6
2½ hours		3·5	3·7	4·1	4·4	4·5	4·7	4·9	5·5	5·8	6·1	6·4
3 hours		3·9	4·2	4·5	4·7	5·0	5·2	5·5	5·7	6·1	6·4	6·7
3½ hours		4·2	4·5	4·7	5·0	5·3	5·5	5·7	6·0	6·4	6·7	7·0
4 hours		4·5	4·8	5·1	5·3	5·6	5·9	6·0	6·2	6·8	7·1	7·4
4½ hours ...		5·0	5·3	5·6	5·8	6·1	6·5	6·7	7·0	7·3	7·7	8·0
5 hours ...		6·5	6·8	7·2	7·6	8·0	8·4	8·7	9·2	9·6	10·1	10·5
5½ hours ...		8·1	8·6	9·0	9·5	9·9	10·2	10·6	11·4	11·9	12·4	12·9
6 hours ...		9·6	10·2	10·7	11·2	11·7	12·2	12·7	13·2	13·7	14·2	14·7
6½ hours ...		10·3	10·8	11·3	11·8	12·4	12·9	13·4	13·9	14·4	14·9	15·4

Table (C). Illustrating Main Predictions and Reduction Table.

To-day, astronomical tractive forces are seen to have complicated effects on oceans, seas and gulfs, dependent upon their natural periods of oscillation. In addition, the results of the earth's rotation are now seen to be a cause of what are known as "amphidromic" points, or sites where there is no tidal range, the cotidal lines radially disposed around them with range contours extending outwards with increasing range values in a very roughly concentric manner.

which double low waters and high waters occur are near a nodal line or amphidromic point.

The writers of the "Admiralty Manual of Tides" show that in the vicinity of the Isle of Wight the phase relations between the semi-diurnal and quarter-diurnal tides are most favourable for the production of double high waters and that if the Isle of Wight did not exist then these would have tended to give double high waters at

the double high water and Young Flood features as actually observed. A list of the main harmonic constituents is here tabulated and reproduced by the permission of the Liverpool Tidal Institute. (See Table E).

In concluding their remarks on Southampton, the writers of the Admiralty Manual very definitely state that no simple explanation can be given as to the mode of the production of the double-high waters at Southampton.

Tidal Features of Southampton Water—continued

It is also observed that even direct harmonic methods cannot alone give satisfactory predictions owing to the large number of species of shallôw-water constituents that would be required. The accuracy of existing predictions is due to a system of shallow-water corrections which are applied to the primary resultant curve from harmonic predictions.

It may be of interest to recount a special practical problem which arose soon after the writer took up his duties at Southampton.

The advertised depth in the approach channel to the docks above Fawley was 35 feet at M.L.W.S. and requests for "safe" margins and times of arrival for given draughts were being received increasingly from agents, captains and pilots responsible for scheduling and handling heavy ships drawing up to 39 feet near Low Water times, particularly at Springs.

The solution of this problem for the benefit of all concerned involved a threefold investigation:—

(a) How much did ships increase their virtual draught when proceeding at harbour speeds in those reaches of the channel which had shallow margins and narrowest widths?

(b) What was the best method for the prediction of intermediate tidal levels on the flood near L.W. times? As stated above, ebb periods near L.W. time were unacceptable to such ships handling with close margins.

(c) Could indications of these meteorological perturbations, especially those which would lower levels at such times, be given, even approximately, for guidance?

With reference to (a) theoretical estimates based on data received from many sources, were confirmed by a valuable experiment conducted in S.S. Bremen in 1936 whilst proceeding outwards towards Calshot.

Alteration of trim was measured throughout on a large radius liquid level and checked by continuous observations using a surveyor's level with a graduated staff over a 100 fore and aft foot base set up on the boat deck.

Absolute "bodily settlement" was inferred from the maximum change of water level observed at the Calshot Automatic Tide Gauge at close passage. (See Fig. 2.) Theoretical considerations indicated that such would exceed actual bodily settlement, but admittedly the determination was not highly satisfactory, although it is considered that the values would be small in comparison with those occasioned by trim alteration.

General results showed that a bodily settlement of about 6 inches could be assumed and an accurately observed increase of trim by 1 foot 3 inches more by the stern was added. The total increase of stern draught was accordingly taken as nearly 2 feet — a figure now confidently accepted and confirmed as safe in local practice for scheduling such ships.

A repetition of more precise experiments with better arrangements for determining bodily sinkage values amidships is clearly called for, and it is hoped that such may be carried out in the near future.

A practical hydraulic allowance for clearance having now been determined, the problem referred to in (b) requiring close prediction of intermediate and changing tidal levels, on the Flood particularly awaited solution.

The writer is indebted to Dr. A. T. Doodson for invaluable assistance in arriving at a satisfactory solution in two stages.

The first was an improvised harmonic tidal predictor using a series of concentric discs, not unlike gramophone records, for dealing with roughly 30 tidal constituents with differing phase lags and periods supplied by the Liverpool Tidal Institute.

Using an entire staff as recorders, it was possible to compute the required 12 hour curves for each half foot of tidal range at and between Springs and Neaps.

The results were found to be very uniform and considering the nature of the requirement a bias towards synthetic curves giving "least rise" guided the selection of the final values accepted. A possible stand or fall in the Young Flood due to supervening meteorological causes was always borne in mind.

The results have since been embodied in the Official Tide Tables of the Southampton Harbour Board and are normally within 6 inches of observation.

Such are connected with the main predictions by "range letters" for each day, enabling adequately close predictions of levels to be made for any time through this year. See Table C).

The increments of rise are found simply by entering the Reduction Tables with Tide Letter for the particular flood or ebb

METEOROLOGICAL CORRECTION TABLES (Revised 1937).

[A]—BAROMETER TABLE.

Barometer.	Correction.
28 ·50	+2 ·6 feet
28 ·75	+2 ·3 feet
29 ·00	+2 ·0 feet
29 ·25	+1 ·7 feet
29 ·50	+1 ·2 feet
29 ·75	+0 ·7 feet
30 ·00	+0 ·2 feet
30 ·25	−0 ·5 feet
30 ·50	−1 ·2 feet
30 ·75	−1 ·8 feet

[B]—WIND TABLE.

Direction.	Fresh.	Heavy Gale.
N.	−0 ·7 feet	−1 ·5 feet
N.E.	−0 ·7 feet	−1 ·5 feet
E.	−0 ·3 feet	−1 ·0 feet
S.E.	−0 ·2 feet	−0 ·5 feet
S.	0 ·0 feet	0 ·0 feet
S.W.	0 ·0 feet	0 ·0 feet
W.	0 ·0 feet	0 ·0 feet
N.W.	−0 ·3 feet	−1 ·0 feet

Over 30 ·00 with very strong NE gale low water may fall to 2 ·0 feet below prediction in very exceptional cases.

Corrections from Tables [A] and [B] to be applied to Predicted Heights.

The corrections are given in feet and decimals (+) or (−) to heights predicted in the Main Tables or derived from the Reduction Tables.

The approximate corrections given in this Table are average figures based upon the official predictions for previous years.

The "Heavy Gale" column gives maximum values, and should certainly be used when the correction is minus, in order that a safe margin be given.

Table (D).

tidal curve, covering the relevant ship movement in about two hours. Such necessarily approximate predictions were very much better than nothing and almost always within 1 foot of the observed value under normal meteorological conditions. A discretionary allowance plus the 2 foot hydraulic clearance gave most valuable information and successfully safeguarded those concerned.

The labour involved, however, was considerable and caused partial dislocation of a small staff whenever such requests were made.

A simpler and much more reliable method was indicated by Dr. Doodson, namely, acceptance of the assumption that the shape of the tidal curve (if diurnal inequality is neglected) depends upon the range of the tide.

It was accordingly decided to use the time and level of astronomically predicted Low Water at the Town Quay as data of reference and to analyse a long series of tidal curves to ascertain the stability of period and the time interval from nearest Low Water. The result is added to the predicted level of the Low Water referred to, corrected approximately for meteorological perturbations.

This brings us to the final requirements under (c). It is, of course, obvious that such Meteorological Correction Tables combining the "barometric correction" proper, with a further correction for average effects of wind force and direction prevailing locally at the time, cannot give consistently accurate predictions **in every particular case,** although results can be very useful in a general sense.

The valuable researches and admirable objectives of the Liverpool Tidal Institute indicate that a long series of observations relating local disturbances to wind, local and remote atmospheric pressure systems, their gradients and rate of travel, by highly complex theoretical conceptions and widespread observations, are essential if the meteorological "tide" at any given time is to be known with real certitude.

Tidal Features of Southampton Water—continued

Such an objective has actually been achieved in the Thames area—a remarkable accomplishment of which inadequate public notice has been taken—and it is understood that similar analyses to this end are contemplated for the English Channel area.

In the meanwhile, a very general analysis based on averages over a considerable period and relating divergences to prevailing wind strengths has been attempted at Southampton, and such has proved to be of considerable value to local seamen, particularly in anticipating probable extreme low levels which are likely when a "below datum" tide coincides with high pressure and strong local N.E. winds. Conversely, high level floodings affecting local transport and dock pumping stations have been successfully foreseen.

The local meteorological correction tables incorporated in the Southampton Official Tide Tables are here given. (See Table D). Incidentally, it may be of interest to give the levels of recorded extreme high and low water at Southampton (See Fig. 3.)

The highest level of 16-ft. 9½-in. above Port Low Water Datum was recorded on 24th November, 1927.

The lowest level of 2-ft. 8-in. below datum was recorded on 6th February, 1935.

The present article would be incomplete without a reference to some remarkable features of Neap Tides wherein a Second Low Water is attempted due to meteorological causes at the time when the Young Flood feature normally occurs. (See Fig. 3.)

From the point of view of the Hydrographic Surveyor, it is necessary to have permanent accurately levelled visual tide gauges at approximately one-mile intervals above and below Calshot to ensure that reductions to soundings are representative of the area under survey, and particularly when rapid survey of long reaches may involve the selection of individual gauges and the "meaning" of selected pairs of gauges to cover the particular line of soundings. The importance of this precaution in framing accurate specifications in dredging contracts need hardly be emphasised.

The coming use of R/T from tidal stations will enable gauge levels to be recorded inboard during survey, selected or "meaned" as requisite, and directly applied to soundings or set to give accurate stylus recording on the Echo Sounding record.

HARMONIC CONSTANTS FROM HOURLY HEIGHTS.

C	H.	g.		C.	H.	g.			H.	g.			H.	g.	
Ao	7.901	-	m	OO_1	.059	311.2	-	$2SM_2$	.077	218.4	m	Mk_3	.053	111.5	m
Sa	.156	219.6	m	J_1	.023	113.8	m	K_2	.425	16.9	m	M_3	.019	263.6	m
Ssa	.118	254.1	m	K_1	.287	114.2	m	R_2	.064	359.2	-	$2Mk_3$	.023	315.7	m
Mm	.175	79.9	-	S_1	.021	87.7	m	S_2	1.334	15.1	m				
Msf	.097	78.6	-	P_1	.068	95.9	m	T_2	.111	31.2	m	S_4	.063	170.8	-
Mf	.107	193.9	-	M_1	.014	128.4	-	L_2	.202	325.4	m	Mk_4	.172	79.6	-
				O_1	.112	5.2	m	λ_2	.105	350.2	-	MS_4	.542	77.4	-
				P_1	.035	4.8	-	M_2	4.460	329.2	m	M_4	.817	18.9	-
				Q_1	.032	264.4	m	V_2	.134	296.5	m	MN_4	.246	12.9	-
				$2Q_1$	.022	231.6	-	N_2	.912	310.2	m				
								U_2	.059	349.4	m	$2SM_6$	.160	264.2	-
								$2N_2$	.124	243.7	m	$2MS_6$	.609	201.3	-
												M_6	.575	147.6	-
												$2MN_6$	.210	119.4	-

C = Constituent
Ao= Mean Level
H = Height Amplitude in feet.
g = Phase lag in degrees.

HARMONIC SHALLOW WATER CONSTANTS.

	1st H.W. Height		1st H.W. Time		2nd H.W. Height		2nd H.W. Time		L.W. Height		L.W. Time	
	H	X	H	X	H	X	H	X	H	X	H	X
MM	-.100	-	-39.26	-	.386	-	70.87	-	-1.169	-	-73.28	
Sn	.175	62.8	8.30	102.3	.138	74.9	3.98	99.5	.298	35.4	5.38	93.3
ML	.148	90.9	4.38	186.4	.120	132.2	3.37	233.5	.152	119.9	2.98	215.6
MS	.097	144.8	6.19	237.2	.282	182.6	7.69	18.7	.774	202.9	5.35	331.4
MK	.137	193.0	2.00	125.4	.158	174.6	3.49	135.1	.277	202.9	1.34	174.3
S	.038	151.1	0.99	94.2	.033	142.0	2.51	348.3	.080	157.4	0.47	0.0
SL	.096	220.6	3.19	241.8	.161	186.5	1.45	165.6	.033	57.9	0.53	35.4
SS	.031	125.9	1.59	71.8	.069	221.9	2.37	210.4	.112	27.6	1.91	127.1
SK	.075	56.9	0.80	227.1	.022	347.6	1.21	123.2	.130	356.4	1.15	104.8

Table (E). Southampton (Town Quay). List of Constituents in text.

In concluding this brief set of practical observations on the tides at Southampton, it is clear to all that all ultimate future developments must adjust dredged levels to utilise the Young Flood feature, which has received much less prominent notice than the more anciently publicised and spectacular Double High Water phenomenon.

The future development of nuclear energy for peaceful purposes in years to come will almost certainly detach some old industries from their traditional power hinterlands, and such must almost inevitably bring newer and cleaner factories down to the Hampshire Basin, where the Port of Southampton, richly endowed by Nature and relieved from the normal necessity of a complex locking system, exists to serve them as a gateway of empire and world commerce.

Here lies a natural harbour, admirably sheltered within the Isle of Wight, crowned with a stable tidal regime, presenting features without parallel in the British Islands.

It is a curious reflection that the local effects of the geological movements of the earth's crust, extending from the period of mountain-building and earth-folding (known as the Alpine Revolution) of the Tertiary period, up to relatively recent times, have seemingly combined to provide a set of coincident features in Southampton Water, which, from a Conservancy angle, are remarkably favourable and can be summarised as follows:

About 20 million years ago the folding in an east and west direction, and under water, was the first step in preparing for that very remarkable natural breakwater, the Isle of Wight.

During the successive climates which followed, including the Ice Ages, the land was apparently raised above modern levels and the English Channel became a fresh water river, draining the French and North Sea basins into which the Solent River flowed through Southampton Water and the East Solent.

Soon after 10,000 B.C., a wide submergence in the present English Channel area commenced, after the retreating of the last Ice Age, and at about 7,000 B.C. the Straits of Dover, as we now know them, were formed. By about 3,500 B.C. the Solent River, with its once tropical flora and fauna, had so subsided as to give approximately the surface features which remain to our own times.

It appears to be very probable that this configuration, besides providing a remarkable land-locked estuary, has, owing to its shoal water effects on the tide, usefully accentuated the high water peaks of the double high waters, particularly in the upper reaches above Hythe, and for reasons above given has so modified phase relations between semi-diurnal and quarter-diurnal tides as to give a flood period of nearly 6½ hours, contrasted with an ebb period of only 3¾ hours in the tidal cycle,

Tidal Features of Southampton Water—continued

a feature unusual in most estuaries, and a boon to all concerned with conservancy operations. (See Ad. Man. Tides, Art. 26.7, para. (5).)

In addition, subsidence of this area in recent geological times has left the bed of the estuary very free of alluvium and rendered it favourable for the development of deep and stable sea channels with comparatively little siltage. Added to this, the direction of the prevailing south-westerly wind is at right angles to the lie of Southampton Water and the conditions for swell and wave making in gales are thus greatly limited.

If one may also point out that the shoal margins of the approach channel to the docks are particularly favourable for the establishment of simple fixed radar reflector beacons and that the incidence of really bad visibility in this area rarely exceeds 30 days per annum, it would appear that the real history of the Port of Southampton has yet to be made, with the collaboration of the newer sciences.

The author acknowledges with thanks the Southampton Harbour Board's kind permission to reproduce the accompanying tidal curves and data.

The Health and Welfare of Seafarers and Dock Labourers

By H. C. MAURICE WILLIAMS, O.B.E., M.R.C.S., L.R.C.P., D.P.H.*

The 5th of July, 1948, will long be remembered as the day on which the medical structure of this country underwent a complete transformation.

Successive governments had for many years given support to the idea of a State Medical Service, but it was only when the present legislature passed the National Health Service Act of 1946 that this conception became a reality.

In 1911 Mr. Lloyd George introduced the National Health Insurance Act, which conferred certain medical and sick-pay benefits on a limited section of the community. Workers between the ages of 16 and 65 years receiving less than £480 per annum were entitled, in return for a weekly contribution, to receive medical attention and medicine from a panel practitioner of their choice. Present-day standards of social welfare and security, however, demand a more comprehensive system of medical care based on the commonsense conclusion that the economic wealth of the country is dependent on the health and consequent working capacity of its component units.

The new health service provides free hospital treatment, medical consultation, domiciliary visitation and medicines. There is, however, one aspect of medical care which is of the greatest significance in the preservation of positive health and the prevention of illness which is not fully catered for by statute, namely, that which is termed "Industrial Medicine."

During the years of war and since, the necessity of maintaining the highest degree of efficiency in the factories has been of extreme importance.

This fact has led to the engagement of Medical Officers, experienced in this particular work, by most of the larger industrial undertakings. Their duties include medical examination on entry, routine periodical re-examinations, facilities available for accidents and emergencies, together with the necessary apparatus for rehabilitating the worker after injury or illness. The Medical Officers are also able to give valuable advice on ventilation, heating, fatigue and the avoidance of hazards peculiar to the particular industry. This combination of medical facilities has undoubtedly contributed to a marked reduction in absenteeism by sickness.

Dock workers, as a section of the working community, have rarely enjoyed these amenities. One might well ask the reasons for this omission. The answer is due to a number of factors. In the first place the docks usually cover a large area, with a variety of work under different employers. There is also the irregularity of hours amongst many of the workers. A combination of these obstacles has led to a reluctance on the part of the authorities in organising a comprehensive scheme.

Sir Alexander Macgregor, whilst Medical Officer of Health for Glasgow, during the war introduced a temporary scheme for dealing with dock workers. This was started because many of the medical practitioners normally undertaking this work had been called up for Military Service. It was therefore agreed by the Glasgow Corporation that Medical Officers employed on Port Health duties should assist in dealing with casualties, and on occasions, with sickness occurring on vessels in the port. The scheme went further by allocating special hospital accommodation for seamen and dock employees, the provision of an ambulance launch for transferring cases in the river and dock area, together with the appointment of liaison officers between the Hospital, the Shipping Federation, the Seamen's Unions and other interested bodies.

The National Dock Labour Board have recently come to an agreement based on somewhat similar lines with the Bristol Corporation, whereby the Assistant Port Medical Officers, who are normally employed in carrying out statutory duties under the Port Health Regulations, are jointly engaged in conducting clinics established within the precincts of the Avonmouth docks for dealing with sickness, venereal diseases and casualties amongst the workers and seamen. These will usually occupy at least half the Medical Officers' time. Similar approaches have been made by the National Dock Labour Board to other Corporations administering port health areas, but as far as is known, Bristol to date is the only port who have accepted a joint scheme. The National Dock Labour Board have recently made a number of full-time appointments of medical officers to undertake this work.

There will undoubtedly be difficulties in working these joint appointments because of the fact that the arrival of vessels is often irregular so that the Port Medical Officer will not always be available to undertake both closses of work. This should not, however, deter Dock Authorities from establishing a medical scheme, whether this is undertaken by full-time medical officers or arrangements made for part-time practitioners living in the area to undertake the work.

The advantages of providing these facilities are illustrated in a paper read by Dr. George Buchanan, Medical Officer on the Clyde, on "Medical Care for Dock Workers." He stated that prior to the war first-aid facilities for dock workers were of a standard prescribed by the Factory Act of 1937. He found after investigation that by giving first-aid treatment with a minimum of delay many of the major industrial accidents were alleviated particularly the sepsis rate, in the Glasgow area, which was reduced from 15 per cent. to 3 per cent.

Dock Authorities who have decided on providing such a service should pay attention to the siting of these clinics, which should be in an area of the docks which provides a large congregation of workers, and it is also important that the clinics should have good road and turning space for ambulances.

The minimum accommodation of each clinic should consist of a doctor's consulting room; treatment, shock, and rest rooms. During the busy working hours of the day a State Registered Nurse should be on duty in addition to the Medical Officer. For the rest of the working hours the clinic could be manned by men or women trained in First-Aid by the St. John Ambulance Brigade, St. Andrew's Ambulance Brigade, or the British Red Cross Society.

Consideration might also be given to having attached to one of the principal dock clinics a small physiotherapy unit, which could be staffed by part-time personnel normally attached to the main physiotherapy department of the town. This service would be provided by the Hospital Group Management Committee in conjunction with the National Dock Labour Board. These facilities for rehabilitation would undoubtedly save a great deal of time for those workers who are fit to return to light work, but who are still

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The Health and Welfare of Seafarers and Dock Labourers—continued

in need of physiotherapy treatment for such conditions as fractures, injuries, and sickness. These men are at present obliged to absent themselves for part of the working day to attend as out-patients in general hospitals often some distance from their work.

It is difficult to produce any evidence indicating that dock work is more hazardous than other occupations. Before the war the irregularity of employment, with long exposure to weather, was conducive to a lowering of resistance to certain diseases. Nowadays, with a more guaranteed state of employment and minimum wages, working conditions have greatly improved.

If the facilities already enumerated are provided for the dock workers they will be in the same happy position as their fellow workers in other branches of industry. It must be remembered that they are entitled to the full benefits of the new health service as provided for every member of the community.

With regard to seamen, the medical facilities are dependent on the type of vessel on which they serve. Those employed on vessels carrying a surgeon are in the fortunate position that they are able to seek medical advice with the minimum of inconvenience, and when ashore they, like other members of the community, are offered the same facilities for medical treatment and hospitalisation.

Seamen on the smaller vessels that do not carry a surgeon are, of course, in a different position and are dependent for the treatment they require during the voyage from the information contained in The Ship Captain's Medical Guide. The treatment is usually administered by the First Officer or the Chief Steward, and wireless communication with vessels carrying a doctor is sometimes sought during the voyage.

Although I have pointed out that seamen on the larger vessels have the advantage of medical services close at hànd, there is still room for improvement in the medical care on some of the vessels. It is essential that all ships' surgeons should undergo annually a post-graduate course of at least one month. This post-graduate instruction should include revision in modern medical and surgical technique, and in addition, training in the examination of bacteriological specimens such as throat swabs, urethral discharges, sputum for tubercle bacilli, etc.

The Ministry of Transport requirements for medical stores and equipment does not at present include a microscope. This piece of apparatus, together with an incubator and staining materials, should be an essential part of the equipment provided in all ships carrying surgeons in order that they may carry out the necessary examinations during the voyage.

The seaman has always had to contend with special health risks. For centuries the living conditions on board ship were appalling. Dr. Johnson described the life of seamen in the latter part of the eighteenth century in the following terms:—

"A ship is worse than a jail. There is in a jail better air, better company, better conveniency of every kind; and a ship has the additional disadvantage of being in danger. When men come to like a sea life, they are not fit to live on land. Men go to sea before they know the unhappiness of that way of life, and when they have come to know it, they cannot escape from it, because it is then too late to choose another profession; as indeed is generally the case with men when they have once engaged in any particular way of life."

Nearly two centuries have passed since these words were uttered, and great changes have taken place in the general standard of life. Nevertheless. they still contain an uncomfortable modicum of truth. For example, the comfort and amenities of crew accommodation have lagged behind the progress made in other essential industries, particularly in the case of some of the small tramp vessels engaged in the coastal trade.

Nor are the owners of some of our largest passenger liners free from censure, particularly in cases where the crews' quarters conform to no more than the minimum standards laid down by the Ministry of Transport, and the extra space thus gained is devoted to what often appears to be extravagant passenger accommodation, much in excess of reasonable comfort.

One recognises, of course, that a ship is a structure of limited dimensions, and that the vessels must run as economically as possible, but even so the world's premier maritime nation cannot be excused when its standards fall short of others—particularly those of the Scandinavian countries.

Before the last World War the public conscience was stimulated through the medium of a national publicity campaign in an attempt to rid our towns and countryside of slum dwellings. But slums are not confined to shore habitations. Thus, Greenwood Wilson, of Cardiff, in a paper delivered to the Association of Port Health Authorities on the subject "Slum Clearance at Sea," called for similar remedial measures in connection with British vessels in which the crew accommodation still falls short of modern standards.

Reliable information regarding morbidity and mortality rates amongst seamen as compared with those of men in other occupations is sadly lacking, as is evidenced by the contradictory statements which from time to time make their appearance.

For instance, Dr. Black, in an article published in 1945, says that "statistics show that seafaring is an occupation with a high mortality and the British seaman's health gets less attention than that of his fellow-countrymen." He further contends that many of the regulations are loosely interpreted, and emphasises the necessity for two main improvements—the need for an increase in the space standard in sleeping quarters, and the need for the plans of all new vessels to be passed by a Medical Officer experienced in Port Health work before construction is begun. This latter recommendation is one which is applied in connection with all new ships constructed for the Royal Navy.

In 1933, Dr. P. G. Edge, of the London School of Tropical Medicine, prepared a report at the request of the Board of Trade, in which he stated—"as far as deductions are practicable it appears that service in the Merchant Marine is no more inimical to life and health that many of the occupations ashore regarded as healthful."

Dr. Greenwood Wilson, of Cardiff, collated statistics of the occupational incidence of respiratory tuberculosis covering a period of eleven years prior to the war. His conclusions are illuminating.

He found in Cardiff that of the 3,072 males notified, 445 were seamen, giving a percentage of 19.07 as compared with 328 labourers, giving a percentage of 14.06.

In figures relating to six of the principal seaports in the country he further showed that the death rate in these ports was appreciably higher than the rate for the rest of England and Wales over a period of ten years.

Finally, analysing the individual rates in the municipal wards, he found that the death rate in a ward mainly occupied by seafarers was more than double that of any of the other wards in his city.

From this and other cognate investigations he concluded that seafaring is an industry that predisposes to tuberculosis, and if such is the case, it is to be hoped that the medical examination of the crew before and at the end of a voyage will in time include an examination by miniature X-Ray.

For centuries scurvy was the principal scourge of our seamen. Vigorous measures were introduced to eliminate this disease. The Dutch East India Company sent Johan van Riebeck to the Cape to establish a vegetable and fruit garden in order to supply the seamen with fresh fruit and vegetables containing the essential vitamin, the lack of which is the cause of the disease. By the knowledge gained Captain Cook was able to sail to Australia without losing a single member of his crew from this disease which had previously taken such a heavy toll of human life.

To-day tuberculosis is the principal scourge we have to contend with and vigorous methods are called for so that our present scientific knowledge may be made full use of in diminishing the incidence of this disease.

The nature of his calling renders the seaman particularly liable to the Venereal Diseases, and his potentiality as a disseminator is therefore one of great importance, as has been emphasised as the result of two World Wars.

Upon the Port Health Officer there accordingly devolves a special duty in relation to the problem of venereal disease control.

The first line of defence is the Ship's Surgeon, and his services can be helpful in the following respects:—

The Health and Welfare of Seafarers and Dock Labourers—*continued*

(1) By educating the crew in the perils of venereal disease, and explaining how these can best be minimised.

(2) By describing the early symptoms, and emphasizing the great importance of obtaining medical advice at the earliest possible moment.

(3) By preserving the confidential relationship between doctor and patient. Failure in this respect has resulted in some instances in the penalisation of crew members, and in others it has led to the suppression of information—consequences which cannot be deplored too strongly. Serious consequences have also frequently followed from neglect to seek early and competent advice and treatment, and also from wrong or inadequate treatment being meted out by unskilled shipmates.

Provided that secrecy is maintained there should be no objection to all venereal diseases cases being made notifiable to the Port Medical Officer on arrival at port. Such notification should be accompanied by an account of the diagnostic and remedial treatment carried out prior to docking.

This implies the necessary services being available on the ship, and the opportunity to study modern methods at the clinics should be afforded to all ship's surgeons.

The availability of prophylaxis is of debatable value, but among bodies of men subject to disciplinary control the results have been encouraging.

Before signing on for a fresh voyage, patients previously referred by the ship's surgeon should be required to produce a Certificate of Fitness for Sea, issued by the Port Venereal Diseases Officer. Ships' surgeons have been known to complain that crew members have not reported for advice at the port clinic, and, as a result, have reported sick on a subsequent voyage.

Because of the short time that some patients are in port, facilities for the speediest possible diagnosis and on-the-spot treatment are desirable. Local advertisement of available facilities does not seem enough, since ignorance of these is often pleaded as the cause of failure to report for advice. The Port Health Authority should make certain that all the crews of each ship boarded are made aware of the address of treatment centres, and the hours during which they are open for treatment. A notice posted near the gangway is the easiest method.

In Southampton subsidiary venereal diseases clinics have been established in the dock areas to expedite diagnosis and treatment.

These are in addition to the Town Clinic, and they are under the continuous supervision of the Venereal Diseases Officer. Since their establishment there has been a better attendance among seamen, who, in the past, have found it difficult to leave their ships for the time necessary to attend at the Town Clinic.

Problems in the future include contact tracing and the follow-up of cases during treatment and observation. The ultimate goal is that this should be on an international footing. Methods of diagnosis and treatment have far outstripped the field-work side of venereal diseases control, and, in a seaport, the part played by the social worker is of the greatest importance.

The question of placing the venereal diseases on the list of Notifiable Diseases is one which has always occasioned spirited debate, but the introduction of the Regulation 33B since rescinded gave us the opportunity of studying its effects and limitations and appears to indicate that further statutory powers are necessary. Every possible step should be taken to ensure the attendance of all infected persons at the clinics, and to keep them in attendance until the modern and most effective methods of treatment have rendered them no longer a danger to the Public Health.

In **1943**, the Minister of Labour and National Service set up bodies in all the larger ports designated Port Welfare Committees.

Their establishment followed recommendations concerning the promotion of seamen's welfare in ports, adopted at Geneva in **1936**, at the General Conference of the International Labour Organisation, and accepted by the British Government in **1938**.

After a survey undertaken by the Minister of Labour and National Service in collaboration with the Mercantile Marine Department of the Board of Trade (now merged in the Ministry of Transport), the Minister set up in **1940** the Seamen's Welfare Board which is composed of representatives of shipowners, officers and seamen's organisations, and of persons with a knowledge of the work of voluntary bodies interested in the welfare of seamen.

The function of this Board is to advise the Minister on questions concerning the welfare of British, Allied and Foreign seamen in British ports, and of the crews of British ships in ports overseas.

The Port Welfare Committees are constituted on the same lines as the Seamen's Welfare Board, with the addition of representatives of Local Authorities and of the Consular Corps. With the assistance of full-time secretaries the Committees concern themselves, amongst other matters, with hostel accommodation for the seamen whilst in port, and provision for the visits of wives and relatives.

In the past many seamen have found it difficult to find clean and comfortable places where they could obtain decent sleeping quarters and good food at reasonable prices. This became more evident during the war years when regular services were discontinued and seamen seldom found themselves in their normal home port. Although good work has been undertaken by National Voluntary organisations and by the local Sailors' Homes and Societies, action was necessary to co-ordinate the work of these bodies by the representative Council of Seamen's Missions and Sailors' Homes set up in **1929** under the auspices of the authorities of King George's Fund for Sailors, which is the central fund for benevolent societies to merchant seamen.

The Port Welfare Committees encourage these organisations to improve standards and amenities in the hostels, and to provide such facilities as good sleeping accommodation, generally in single rooms or cubicles, baths, changing-rooms, reading, writing, billiards, recreation and dining-rooms. The Hostels have generally a Resident Manager and his wife, who have full catering experience, knowledge of the ways of the merchant seaman, and of the seaman's likes and dislikes.

Another important side of the Port Welfare Committee's work is the provision of recreational facilities. It is found that in many cases there is need for the extension of existing clubs and institutes, and further provision of facilities for playing out-door games.

The work of the Hospitality Committees, set up in **1940** at the main ports to ensure that proper arrangements were made for the welfare of Allied Seamen, has to-day, to a great extent, been absorbed by the Port Welfare Committees. Non-European seamen have also to be provided for, including Chinese seamen, Arabs, Africans, and West Indians. In some of the larger ports special clubs and hostels have been set up for their welfare.

Another aspect of the work undertaken is the general health of the seamen. Steps are taken to preserve the continuity of health services between ship and shore, to make available to merchant seamen all the benefits offered by the National Health Service; to facilitate the admission of merchant seamen to hospital and convalescent homes; to promote the establishment of clinics in port to which seamen can go for treatment and advice; to establish bathing facilities in ports, and to provide for the treatment and prevention of scabies, etc.

No section of the working community are more deserving of consideration than the men of the Merchant Navy. In two World Wars they have saved this Island from certain starvation and distruction. It is therefore hoped that their health and welfare will always be in the forefront of the public conscience.

The Dover-Dunkerque Ferry: Increased Traffic During 1948.

Over one hundred thousand passengers of the one million three hundred thousand who travelled by Southern Region Continental Services in **1948** used the Dover-Dunkerque train ferry sevice, which also carried more than ten thousand cars during the year. This represents an appreciable increase over the previous year.

Cargo by the Train Ferry services during **1948** totalled one hundred and fifty thousand tons, and included imports of fruit, vegetables, nuts, cheese, wine, spirits, poultry and large quantities of dates.

Export traffic consisted of Australian wool to manufacturing areas in Northern France, machinery, steel and metal products, and in the last quarter of **1948** over one thousand five hundred cars and motor cycles.

Notes of the Month

Port of New York Traffic.

During 1948 a total of 22,379 vessels entered and left the port of New York, compared with 21,779 in the previous year. The arrivals totalled 11,129 and sailings 11,250, compared with 10,806 and 10,973 respectively for 1947.

Admiralty Raises Sunken Dock.

A large Admiralty floating dock, sunk by bombing in Malta Grand Harbour during 1940, has been raised and towed away for breaking up. The dock was 960-ft. in length, 180-ft. in breadth and 70-ft. in depth, and the salvage of the dock means a total of about 27,000 tons of steel will be available for scrap.

Large Dry Dock for Port of Naples.

A British United Press announcement says that the largest dry dock in the Mediterranean is to be completed at Naples with part of 20,000,000,000 lire (about £8,750,000) released to the Italian Government by the Economic Co-operation Administration. A new petrol dock at a cost of 1,300,000,000 lire (about £565,200) will also be built there.

New Port in Chile.

San Vincente, a new port near Talcahuano, Chile, was officially opened towards the end of last year. The port is equipped with an excellent wharf and other modern port facilities, and has been especially designed to serve the nearby Pacific Steel Co.'s plant. This plant is being built with American machinery and materials, and production is expected to begin late in 1949.

New Pier for Port of Tabaco.

A contract for the construction of a new pier to replace the old one at the Port of Tabaco, Albay Province, has been awarded to a Southern Luzon contractor. The contract, which is valued at 294,980 pesos, includes the replacement of the old Tabaco pier and the repair of the old causeways, fender systems and dolphins. The work, which has already commenced, is expected to be finished this year.

Shortage of Pilots for River Hooghly.

It is reported from Calcutta that the shortage of Hooghly river pilots continues to hamper the movement of vessels, and delays of from two to five days, due to the non-availability of pilots, has been caused to ships seeking to enter or clear the approaches to the port. These delays have already cost ship owners thousands of pounds sterling, and there does not appear to be any likelihood of improvement in the position for some time to come.

Aluminium Bridge Passes Load Tests.

The aluminium bascule bridge, which spans the junction between the Hudson and Hendon Docks at the Port of Sunderland, was recently subjected to the usual heavy-load tests. Two tractors drawing a trailer loaded with steel, the total weight of which was 75 tons, crossed the bridge, and the rail traffic test consisted of nine loaded iron ore trucks drawn by a locomotive. Road traffic has been using the bridge for several weeks, and it is expected that it will be opened for normal rail traffic very soon.

Radar Reflectors Suggested for Humber Navigation.

At a recent meeting of the Humber Conservancy Board, it was stated that the port master at Grimsby had written asking whether any decision had been reached regarding the adoption of radar reflectors on floating marks for assisting vessels navigating the river by radar. In reply, the Secretary of the Board stated that no action is being taken pending the findings of the Admiralty signal and radar establishment, who are experimenting to find the most suitable type.

Russian Order for Tugs Under Consideration.

A Russian order for 100 Japanese-built tugs has been received in Tokyo, and is being considered by General MacArthur's headquarters.

Tour by Chief Engineer of Port of Auckland.

It was recently announced that Mr. N. L. Vickerman, Chief Engineer of the Auckland Harbour Board, is to undertake an extended overseas tour in the near future. He will study port development and the latest types of cargo handling equipment, and will probably visit Canada, U.S.A., Egypt, Australia, Great Britain, Ireland and other European ports. He is expected to leave New Zealand early in April and will be abroad from nine months to a year.

St. Ives Harbour of Refuge.

The practicability of using caissons in connection with the proposed harbour of refuge scheme for St. Ives was considered at a joint committee meeting held in St. Ives recently. A letter from the Ministry of Transport stated that, coupled with difficulties of towing, mooring, preparation of the sea-bed, etc., the proposed scheme of utilising Mulberry caissons was in their view impracticable. This was borne out by the fact that of the seven caissons to be raised during this year, only two are suitable for the project, whereas six are required. The joint committee decided to take the matter up further with the appropriate Government Departments, and to take advantage at a later date of the offer of the Ministry of Transport to send representatives to a joint conference in London.

Future of the Falsterbo Canal.

The Swedish Roads and Waterways Administration has prepared a report on the present condition of the Falsterbo Canal, together with estimates of the cost of repairs and completion works, estimated at about 4,000,000k. The canal was cut across the Falsterbo Peninsula, in South West Sweden, during the recent war, in order to allow shipping to pass in and out of the Baltic without having to go through the German minefields, which at that time blocked the deep-water channels off the coast. As it was important to complete the construction of the canal as quickly as possible, certain works were carried out in only a temporary way, and some of the material has deteriorated. The question now arises whether there is a need for the continued existence of the canal in peacetime, and, if so, how the cost of maintenance and working is to be financed.

Development of the Port of Colombo.

Plans for the development of the Port of Colombo, decided upon early in 1946, have now been approved. A comprehensive project aims at speeding up the discharge of imported foodstuffs and general cargo, and improving the speed of discharge of petroleum from oil tankers, and the handling of railway coal, phosphate cargoes and passenger traffic. One of the most important projects embodied in the plan is an oil dock big enough to accommodate the largest tankers. There will also be four oil-bunkering berths and pipelines. To provide facilities for handling railway coal and phosphates, the north-east breakwater is to be converted into a deep-water quay 1,100 feet in length. This new quay will have three lines of railway track with electric capstans for shunting. Construction of warehouses on this quay is also provided for. New two-storey warehouses are to be constructed on a new Delft pier, which will have rail facilities and cranes. A new port for passenger traffic will be constructed under the protection of a pier to be built from the south-west breakwater. Altogether, there will be 14 deep-water berths in the port when the scheme is completed. Another interesting new installation will be a booster pump station for the Guide Pier, where coconut oil is loaded.

The Decca Navigator System

Official Opening of Lane Identification Service

On the 19th January last, the Minister of Transport, The Rt. Hon. Alfred Barnes, M.P., officially brought into service at a radio transmitting station at Puckeridge, Herts, a new radio aid to navigation—the lane identification transmission service of the Decca Navigator System.

With the aid of the lane identification transmissions, all ocean-going ships approaching the coast of Great Britain can now employ the full facilities of the new system. Hitherto, ocean-going vessels could not use it when first entering its area because a reference point was necessary before the equipment could be brought into use. This reference point is now provided automatically by means of special radio transmissions.

At the opening ceremony, Mr. Barnes said that any scientific advance that aided mariners at sea was welcome to the Ministry of Transport, and the introduction of lane identification was a big step forward. It was expected that, as a result of the new development, many more deep-sea ships would now be equipped with Decca apparatus. In deep-sea shipping, as in the home trade, any device that saved ships' time was thereby increasing the earning power of our merchant fleet. Continuing, he said that Decca was not the complete answer to fog. That answer probably lay in a combination of a position-fixing system with some form of radar. But Decca, by giving an accurate fix at any time, did enable a ship to navigate in fog, when seamanship might otherwise require that she anchored because of uncertainty as to her position.

Southampton Docks

During 1948 nearly 14½ million gross tons of shipping were dealt with at Southampton Docks. This was 15% or nearly two million tons more than the 1947 total.

The number of passengers using the port increased by 10,000, the comparative figures being as follows:—

Year.	No. of passengers
1938	560,000
1947	577,000
1948	587,000

British Railways' vessels operating from Southampton on the Cross Channel routes to France and Channel Islands carried nearly 103,000 tons of cargo, 23,000 tons or 28% more than in 1947. The number of passengers who travelled by these vessels increased by over 6,000 from 377,897 in 1947 to 384,070 in 1948.

New Terminal for South African Traffic

Plans have been made by the Southern Region of British Railways for the construction of a new terminal building at Berth 102, Southampton New Docks. Union Castle Mail Line vessels at present dealt with at Berths 34/39 will be handled at this new terminal.

This change has become necessary as trade between South Africa and Southampton has developed to a marked degree with corresponding increases in the size of vessels and their carrying capacity. Latest additions to the Union Castle Mail fleet are "Pretoria Castle" and "Edinburgh Castle," each of 28,800 tons. In 1928 the average size of the vessels on the South African services was only 15,500 tons.

The need to provide modern accommodation for the reception of passengers and the large amount of cargo carried by vessels had become apparent before the war, but provision of better and more commodious premises had of necessity to be postponed.

The new two-storey terminal will be erected on the site of a transit shed destroyed by enemy action during the war. Passengers and general cargo will be handled on the ground floor, where modern waiting and refreshment rooms and telephones will be available. Accommodation will also be provided for Customs and Immigration Authorities. The upper floor will be used for handling bulk cargoes, chiefly wool.

The Institution of Civil Engineers

Permanent International Association of Navigation Congresses.

There has recently been formed, with the approval of the Ministry of Transport, a British National Committee in connection with the Permanent International Association of Navigation Congresses.

The main objects of the Committee are to foster interests in the Association, to promote Papers for presentation at the Congresses (in particular for the next Congress to be held in Lisbon in September, 1949) and generally to act as the co-ordinator of British interests in this connection.

The Council of the Institution of Civil Engineers has consented to administer and provide secretarial facilities to the National Committee.

The Committee, at the request of the Secretary-General of the Association, has agreed to distribute in this country Bulletins, etc., received in bulk from Brussels and also to receive on behalf of the Association subscriptions from members resident in this country for onward transmission in a bulk sum or sums.

The revised rates of subscription recently notified are:—

Corporations—minimum 200 Belgian francs per annum.
Ordinary members—75 Belgian francs per annum.
Life-members—single subscription of 750 Belgian francs.

The Committee offer the facility that payment may be made in sterling at the ruling rate of exchange, by crossed draft or money order in favour of "The Institution of Civil Engineers" and addressed to: The Secretary, British National Committee, Permanent International Association of Navigation Congresses, at the Institution of Civil Engineers, Great George Street, London.

SITUATIONS VACANT.

PORT OF BRISTOL AUTHORITY.

Applications invited for position of MARINE AND DREDGING ASSISTANT to Chief Engineer. Candidates must have had considerable experience in marine and dredging operations, including:—

Repairs and maintenance of Dredgers, Hoppers, Tugs and other Floating Plant.

Periodical and damage surveys of Floating Plant, including deep sea vessels.

Direction of employment of Bucket, Suction and Grab Dredgers and supervision of officers and crews.

Preparation of estimates and reports and conduct of correspondence relative to marine and dredging work generally.

Salary applicable to post is £660 per annum rising by annual increments of £50 to £860, but commencing salary will be adjusted according to qualifications and experience of selected candidate. Position superannuable in accordance with provisions Local Government Superannuation Act, 1937, and successful candidate required pass medical examination. Applicants must disclose whether related to a member or senior officer of Bristol Corporation. Canvassing disqualifies.

Applications, stating age and other relative particulars and enclosing copies of recent testimonials, must reach the undersigned by 10 a.m. on Friday, 25th February, 1949.

N. A. MATHESON,
Chief Engineer.

Port of Bristol Authority,
Avonmouth Docks.

PORT OF MANCHESTER.
ENGINEERING APPOINTMENT.

The Manchester Ship Canal Company invites applications from suitable candidates to fill a senior position on its engineering staff.

Applicants should be Corporate members of the Institution of Civil Engineers and not less than 40 years of age. They should have held executive positions and have been responsible for the initiation, design and successful construction of major harbour works. Their knowledge of construction and maintenance should embrace locks, lock gates, sluices, swing bridges and railways, and they should be familiar with practice affecting dredging and flood control.

The position is an important one carrying a salary commensurate with the responsibilities entailed and offering prospects of early promotion to the post of Deputy Chief Engineer.

The successful candidate will be required to become a member of the Company's Statutory Superannuation Fund.

Applications, which should not in the first instance include testimonials, may be addressed—marked "Confidential"—to the Managing Director, Manchester Ship Canal Company, Ship Canal House, King Street, Manchester, 2.

CIVIL ENGINEERING DRAUGHTSMEN required by Samuel Williams & Sons, Ltd., for work at their Dagenham Dock Estate and in connection with clients' factories in the Greater London area. Applicants should be first-class draughtsmen with sound experience of survey work, including use of level and theodolite. A good salary is offered to a suitable man and the appointment is pensionable. Assistance will be given in obtaining a house, if required. Write: Personnel Manager, Samuel Williams & Sons, Ltd., Dagenham Dock, Essex.

ENGINEERING DRAUGHTSMAN required for progressive position. Experience in mechanical handling equipment or with the installation desirable. Also vacancy for competent detailing draughtsman. Apply to Personnel Manager, Samuel Williams & Sons, Ltd., Dagenham Dock, Essex.

CAPABLE MAN to take charge of vessel mounting 15-ton Lobnitz Rock breaker in Southampton Harbour. Only those with previous experience in the use of this type of equipment need apply to: Reed & Mallik, Ltd., 42 Berth, Old Docks, Southampton. Tel.: So'ton 2431.

DOCKS AND INLAND WATERWAYS EXECUTIVE.

Applications are invited for the post of Staff and Establishment Officer on the Headquarters staff of the Docks and Inland Waterways Executive. Applicants should have experience of negotiations with Trade Unions and Staff Organisations and knowledge of the industrial agreements for the docks and inland waterways industries is desirable. Commencing salary £1,250 per annum rising by increments to £1,500 per annum. The candidate selected will, where eligible, be expected to join a Contributory Superannuation Scheme and in this respect to comply with whatever provisions are decided upon later for the Executive's staff as a whole.

Applications accompanied by relevant particulars must be delivered to the Secretary at the offices of the Executive, 22, Dorset Square, London, N.W.1, not later than 11th February, 1949.